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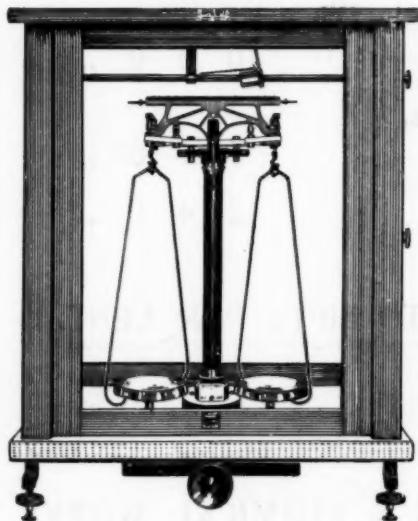
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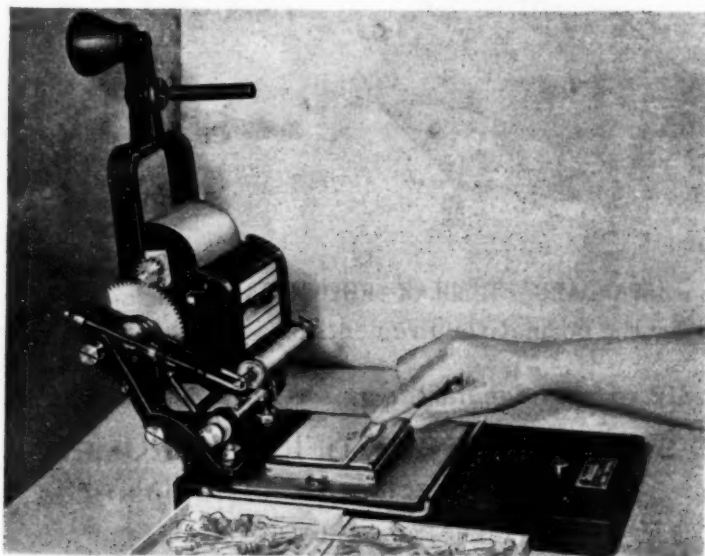
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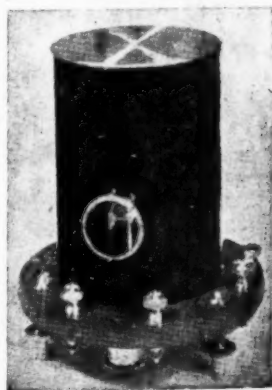
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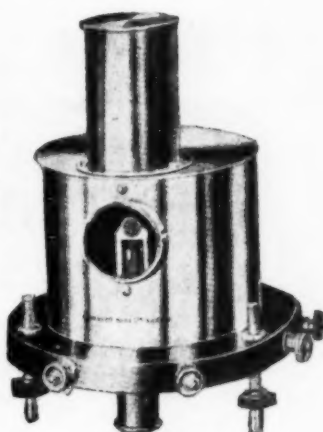
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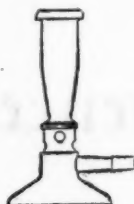
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## MAHATMA GANDHI

AT rare intervals in the history of mankind, there arise personalities, the wide response to whose teachings inspire the hope that man, after all, is progressing in the right direction. The traits of these great personalities are easily described. They embody in themselves and typify all the lofty ideals of social conduct which civilised man cherishes at heart but often fails to adopt in the normal activities of life. These great men are optimists having intense faith in the essential goodness of man, in his sweet reasonableness and in his eventual conversion, by precept and example, to a life of charitable neighbourliness. They leave the impress of their teachings and of their model lives, not merely on their own age but on generations to come. Such was the life of Mahatma Gandhi, and there is little doubt that he will be ranked among the great teachers of the world.

That Gandhi fell at the hands of a misguided youth, moved by narrow sectarianism, is, indeed, no reflection on our civilisation, our land or our high religious convictions. For, in every land and every age, people in all grades of moral evolution are to be found. Their individual conduct cannot be generalised sweepingly as of the generation or of the country. During Lincoln's lifetime there must have been as few men of his calibre as of Booth, his assassin. The world reaction to Mahatma Gandhi's unnatural end makes us believe that his martyrdom, even as that of Jesus Christ, will assure a lasting response to his ideal of *ahimsa*. And the universal veneration which he commanded in his lifetime is further proof that his teachings will not be forgotten after his death.

In every role—as reformer, statesman, ascetic and religious preacher—Gandhi was



truly a revolutionary. Like all great revolutionaries, he was a man of paradoxes: it was difficult to classify his views along accepted lines. He claimed to be a sanataniist, but advocated the equality of all castes; he was a lucid thinker, but an unhesitating dualist in theology; he dedicated his life to the economic and social upliftment of the masses, but unflinchingly advocated atavism in many fields of human endeavour; and finally, though the most doughty champion of the oppressed and the enslaved, he would have nothing to do with violent methods of emancipation.

The most outstanding achievement of Gandhiji, in the field of politics, has been the practice of truth. To him the means was far more important than the end. He has succeeded in showing to the world that diplomacy and tact can go hand in hand with honesty and sincerity of purpose.

Despite differences of opinion and ways of thinking, all men honoured him for his intense sincerity and enormous courage of conviction. His way of reminding the world, that no man has a right to possess more while another has less, was to lead the sim-

ple life of the poor in all its actuality; his way of asking men to be self-reliant was to weave his own cloth and cobble his own shoes; his way of preaching equality of men and religions was to live with them all in loving friendship. These demonstrations, simple as they were, went far towards the promotion of self-respect among his countrymen and of peace between communities.

While India remains ever in his debt for his unrivalled leadership in the final phase of her historic emancipation, the world is grateful to him for the successful demonstration that political disputes between nations can also be settled in ways other than war—by moral force as against military might or machiavellianism, a method which spells failure to neither party, but, like mercy, blesseth him that gives and him that receives. By this exalted method of persuasion Gandhiji exercised a power unprecedented in the history of mankind.

Let us hope that posterity will have no cause to accuse the men of his generation that his life and teachings were lost on them.

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## EDITORIAL NOTE

### MISSIONS ON SCIENCE AND TECHNOLOGY

RECENTLY we have read an announcement that the United States will soon establish a Mission on Science and Technology in the American embassy at London. The object of the mission is to supply interested individuals and commercial firms with information on the latest developments in such fields as organic chemistry, biochemistry, physics, engineering, biology and agronomy, and to collect information on British developments for dissemination to government agencies and scientific societies in U.S.A. The mission will also assist in facilitating exchange of scientific personnel, develop and continue close personal contact with government agencies and research institutions in the United Kingdom, and generally stimulate exchange of reports of scientific and technological nature.

Such friendly contacts between different countries are of obvious benefit to scientists and technicians as well as to the people who depend on them for their material advancement. The establishment of such missions is, further, one of the positive methods of promoting active co-operation in the international sphere. To countries like India and China, with enormous potentialities of economic development, the more technically advanced countries like the United States, Britain and Russia could, by establishing such missions, give a helping hand and accelerate their progress. The United States and Russia are in a particularly advantageous position in this respect, as the agricultural industry is greatly developed in these countries. With their help it is clearly possible to cut short the period of modernisation and to attain the peak of agricultural production and thus help in overcoming the critical shortage of world food supplies. We trust the Government of India will take the necessary steps for the establishment of friendly foreign scientific missions in India.

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## IMPROVING THE POSITION OF MATHEMATICS IN INDIA\*

"It is not to our national interest to ignore the fact that the position of mathematics in the country is far from satisfactory", observed Prof. M. R. Siddiqi in his Presidential Address to the Fifteenth Biennial Conference of the Indian Mathematical Society. Referring briefly to the glorious past that mathematics has had in India, he dwelt on the unsatisfactory present, analysed the causes therefor, and offered some useful suggestions for the future.

Recalling the past, Prof. Siddiqi said, "The whole civilized world acknowledges the debt of gratitude it owes to this great country of ours for its early pioneering efforts in systematic mathematics. The discovery of the numerals and of the positional notation in arithmetic are two of the most fundamental and far-reaching contributions made by this ancient land to the evolution of civilised society. It is hardly possible to calculate the innumerable benefits that the human race has derived by the use of the mathematical discoveries of our ancestors in this country." He mentioned, in particular, the names of Aryabhata and Bhaskara amongst the ancients and of Srinivasa Ramanujan of this age.

After this very brief reference to the past, Prof. Siddiqi deplored the fact that, at present, "compared to the size and the population of our great country, the number of mathematicians is much too small, and the number of those actively engaged in research is smaller still", and that "there are hardly two people in the country working on the same subject". He pointed out that the causes for this state of affairs are the defects in the present system of education, and the tendency of Government to encourage only "industrial research" losing sight of the importance of "fundamental research".

"The present system of education", said Professor Siddiqi, "introduces too early too narrow

a specialisation in the secondary school stage itself, and the young students naturally take up those subjects which enable them to pass the examinations easily, i.e., the arts subjects, or subjects for which there is more or less inflated market-value at present, i.e., Chemistry and Biology .... Of the students who take mathematics in the High School and Intermediate, the majority do so not because they are interested in the subject itself but because they wish to take a degree in Engineering or some other technical subject." Students should not be expected to cram formulæ and reproduce them at examinations, nor should the specialisation be of the type of "knowing more and more about less and less". A system of general education should be introduced with due predominance to mathematics. Reform is necessary even at the university stage, where "much valuable time and energy of the students are wasted in studying topics which have lost any importance that they once possessed". Further, our educationists should appreciate the fact that "mathematics is woven inextricably into the structure of science and technology".

As a possible line for future research in mathematics, Prof. Siddiqi suggested problems relating to the Foundations of Mathematics as the suitable trend for research in this country. He made a rapid survey of the growth of this branch of mathematics, and in doing so, he referred to the rigour introduced by Gauss and Cauchy, to the "arithmetisation" during the 19th century, and specially to the subsequent schools of thought, viz., the Intuitionistic school led by Brouwer and Weyl, the Logistic school of Russel, and the Formalistic or Axiomatic school of Hilbert. Prof. Siddiqi hoped that this branch of mathematics would prove congenial to our countrymen, who have "a reputation abroad for possessing an extraordinary flare for abstract philosophical speculations and reasoning", and that "we may see some further developments in the subject in the near future".

B. SEETHARAMA SASTRY.

## SOME ASPECTS OF PURE AND APPLIED WOOD ANATOMY\*

FOREST wealth is one of our national assets endowed to us by bountiful nature. The towering giants of the Indian forests include species which yield us valuable timber. But in the absence of proper vetting much of this wealth may go to ruin. A sound knowledge of the interior make up of the trees is a *sin qua non* for the classification and understanding of our timber resources. Addressing the Section of Botany, Dr. K. A. Chowdhuri calls attention to the urgent need for sustained work in this branch of knowledge. Among the wide range of characters available to the anatomist only those that are not available are

of any use in classifying wood. Dr. Chowdhuri's studies lead him to believe that rays embedded in fibrous tissue show a remarkable constancy in their shape and of their component cells. Equally so are the ripple marks formed by the rays for quick classification of timbers of broad-leaved trees. The plastic characters cannot be ruled out as criteria of classification, but their limit of variation remains to be determined. Dr. Chowdhuri pleads for more work in this direction.

Thrown on our own resources during the war, we were compelled to look for local substitutes for imported timbers. A number of local timbers proved excellent substitutes: the Indian spruce (*Picea morinda*) and the silver fir (*Abies pindrow*) were found to be as good as Sitka spruce of U.S.A. and Canada for making aircraft.

\* Extract of Presidential Address of Dr. K. A. Chowdhuri to the Botany Section, Indian Science Congress, Patna, 1948.

\* Extract of Presidential Address delivered by Prof. M. R. Siddiqi to the Fifteenth Biennial Conference of the Indian Mathematical Society, held at Waltair, on 22nd December 1947.

After discussing some of his own contributions to the subject, Dr. Chowdhuri refers to gum- and resin-yielding trees. Here the type of incision is of paramount importance.

In the absence of standardised methods, much waste and vital injuries are caused to the trees.

K. V. S.

### THE VARIATION IN STATURE AND CEPHALIC INDEX AMONG BENGALEE COLLEGE STUDENTS\*

THE data embodied in the address were obtained from the routine health examinations of the students by the Medical Board attached to the Students' Welfare Committee of the Calcutta University during 1922-28. The anthropometric measurements were taken according to the Monaco Agreement and were arranged and tabulated in relation to each of the six traditional zones of the province of Bengal, viz., Radha, Varendra, Vanga, Chattala, Samatata and Calcutta, and five caste groups of peoples, viz., Brahmins, Vaidyas, Kayasthas, other Hindus and Moslems. The data reflect the conditions prevalent among the rich and middle classes.

The mean of the stature is fairly equally distributed over the whole province except for Calcutta. There is great resemblance between the first three zones. The last two zones are characterised by a tendency to tallness and roundheadedness.

\* Extract of Presidential Address of Dr. A. Chatterji to the Anthropological Section, Indian Science Congress, Patna, 1948.

Further elucidation of the data is made on the basis of a classification of the individuals into nine types of correlation of stature (tall, medium and short) and Cephalic index (dolicho-, meso- and brachycephals), and the percentile incidence of the different types in the six zones is noted. Further group differences in the six different zones and the zonal fluctuations in the same group on the basis of caste are tabulated.

The fact that there is a great deal of ethnic unity and homogeneity is brought out by the following findings which emerge from the data.

The medium mesocephals and medium brachycephals constitute the most predominant type among the Brahmins and the Vaidyas. The medium mesocephals predominate among other Hindus and the Moslems. There is considerable variation in the Cephalic index among the Kayasthas. Dr. Chatterji, in conclusion, envisages the emergence of a united people with close cultural and linguistic bonds.

C. J. JAYADEV.

### BLOOD-FLUKE PROBLEM IN INDIA\*

COMPARED with any other single group of parasites, blood-flukes or schistosomes rank foremost in undermining the health of almost all domestic animals in India. It is a subject in which both Veterinary and Medical professions are interested alike. Dr. Bhalerao in his Presidential Address has given an idea of the work that has been done in India on these parasites and suggested measures for their control. Reference has also been made to cercarial dermatitis of man which so far as the research of the author has progressed appears to be localised only in certain localities in India.

As a result of the work of Montgomery (1906) and several other workers during the past three decades, seven authentically identified species of schistosomes have been recorded from India, viz., *Schistosoma haematobium*, *S. spindalis*, *S. nasalis*, *S. indicum*, *S. incognitum*, *Ornithobilharzia bomfordi* and *O. nairi*. Of these the first one has been sporadically recorded from man, while the remaining six have been known to parasitise only the domestic animals.

Montgomery first found *Schistosoma spindalis* in the mesenteric vessels of two plain cattle (*Bos indicus*) at Mukteswar and described the morphological features of the adult worm and

their spindle-shaped ova. Bhalerao (1932) discovered in cattle from Bihar another variety of *S. spindalis*, in which the males had a smooth cuticle, whereas the females described by Montgomery had a tuberculate cuticle. It has been observed that alimentary infection with *Schistosoma cercariae* occurs only in ruminants owing to the peculiar anatomical and physiological differences in the stomach of these animals. *Schistosoma cercariae* cannot survive the normal acidity of the gastric content in animals other than ruminants.

Fairly and collaborators developed in this country serological method of diagnosing bilharzia infection. As a result of numerous complement fixation tests it has been concluded that the cercarial antigen of *S. spindalis* is of a group nature and can be used successfully in detecting infestation by *S. haematobium*, *S. mansoni*, *S. japonicum*, *S. boris*, *S. spindalis* and *S. indicum*. Pleural peritoneal and pericardial transudates and exudates will yield positive complement fixation reaction in infected animals provided the blood shows similar reaction. Regarding the treatment, it has been found that tartar emetic is capable of curing *S. spindalis* infection in goats. The female worms are affected more by anthelmintics than by male ones. Intravenous injection of emetine hydrochloride has more efficient anthelmintic properties than tartar emetic, but is more toxic.

Unlike other species of *Schistosoma*, *S. nasalis* occurs exclusively in the nasal veins of the

\* Summary of the Presidential Address delivered by Dr. G. D. Bhalerao before the Section of Medical and Veterinary Sciences, Indian Science Congress, Patna, 1948.

host. Usually cattle and rarely buffaloes are infected, but sporadic cases occur in goats. One case of equine infection was brought to the notice of the author. A thorough description of both the male and female parasite was first given by Bhalerao (1932). According to the available data the disease occurs in Bombay, Madras, Central Provinces, Bihar, Assam, Orissa, Mysore, Bengal and also in Burma. Antimony tartrate is the drug of choice for the treatment of this infestation.

Prior to 1932, *S. indicum* was known to occur only in the horse, donkey, sheep and camel, when Bhalerao (1932) recorded its presence in cattle and goats from various localities in India. Montgomery was the first to describe this species, later Bhalerao (1932) added materially to the original description of this parasite. The life-history of this important parasite still awaits elucidation.

Chandler (1926) recorded from the supposed human stool asymmetrical schistosome eggs with a subterminal spine, and assigned these ova to a new human species of schistosome—*Schistosoma incognitum*. In addition to porcine hosts, *S. incognitum* parasitises dogs as well.

*Ornithobilharzia bomfordi* was found only once in a plain cattle at Mukteswar by Montgomery. Along with *S. spindalis*, Price (1929), assigned this species to the genus *Ornithobilharzia*, remarking that some birds must have been the definitive host of this species and that bovine infection was purely accidental.

Madaliar and Ramanujachari (1945) identified a species from the elephant and designated it *Schistosoma naini*. On account of the anatomical peculiarities of both the male and female worms, this species could not be retained in

the genus, schistosoma, and Bhalerao assigned it to *Ornithobilharzia* in 1947.

There are a few records in this country of indigenous human schistosomiasis. Mello (1936) quotes one definite case of urinary bilharziasis in a child who showed numerous ova of *S. haematobium* in urine and faeces. Recently Andreasen and Suri (1945) reported a case where large number of ova of *S. haematobium* were detected in urine.

From the scanty report, it would appear at the first sight that human bilharziasis is not a very serious condition in this country. It, however, transpires that some molluscs in this country are capable of harbouring the larval stages of the human schistosome, *S. haematobium*, and this fact offers a clue to explaining the sporadic occurrence of the cases of bilharziasis in this country. This need not, however, alarm us, for the clinical, epidemiological and experimental data, obtained so far, do not warrant the conclusion that urinary bilharziasis may become endemic in India.

Cort (1928) was the first to demonstrate that non-human schistosome cercaria produces the "swimmer's itch". Bhalerao recently encountered similar conditions in men bathing in some tanks in the Mysore State. Examination of the snails from the tank revealed the presence of two species of cercariae.

Bhalerao concludes by saying that schistosomiasis, particularly in domestic animals is a very serious condition and causes considerable monetary loss to the stock-owner in this country. Strenuous efforts should, therefore, be made to control this condition. Such measures will not only eliminate schistosomiasis but will also exterminate other fluke diseases, both of men and animals existing in this country.

N. N. De.

## BETA-RAY COUNTERS

R. S. KRISHNAN

(Department of Physics, Indian Institute of Science, Bangalore)

### I. INTRODUCTION

IONISATION chambers and Geiger counters are very frequently used for detecting and measuring the radiations emitted by artificial radio-active bodies. Although ionisation chambers are easily made they are not suitable for measuring very weak  $\beta$  or  $\gamma$ -rays, since a limit to the measurement of very weak radiations is set by the background ionisation or rather by its statistical fluctuations. For reliable measurements with ionisation chambers and electrosopes, the source should be much stronger than that required for measurements with counters. Moreover, ionisation chambers are not useful for studying nuclear isomerism and K-capture by the coincidence method, whereas Geiger counters are indispensable for such studies. Much work has been done and many papers have been published on the construction and performance of Geiger counters. But often contradictory views have been expressed by workers in different laboratories. In connection with the investigations on the deuterium-induced disintegrations in the heavy elements,

the author studied in some detail the methods of construction and behaviour of counters suitable for measuring  $\beta$ -ray activities of radio-active products. The results of these studies which were carried out in the Cavendish Laboratory at Cambridge (which are not at all outmoded now) are presented in this article.

### 2. THE MECHANISM OF EXTINCTION IN COUNTERS

The counter is essentially an ionisation chamber in which the intensity of the electric field is such that a discharge does not set in spontaneously but is started by the ionisation produced by the incoming particles. The discharge thus produced is not allowed to become permanent, but is interrupted automatically after a very short time in order that the apparatus may be reset in a proper condition for registering the next particle. The point and the tube counters work on the same principle, although the tube counter is more sensitive than the point counter. The sensitivity of the counter is not very much influenced by the energy of the particles counted,

Fig. 1 (a) shows the electrical connections of a counter and Fig. 1 (b) is a typical characteristic curve for a counter.  $V_1$  is the voltage at which the counter begins to record impulses. From  $V_{min.}$  to  $V_{max.}$  the number of counts recorded with a given radio-active source remains constant. When the voltage is increased above  $V_{max.}$  the number of impulses increases very rapidly until at  $V_2$  a steady discharge takes

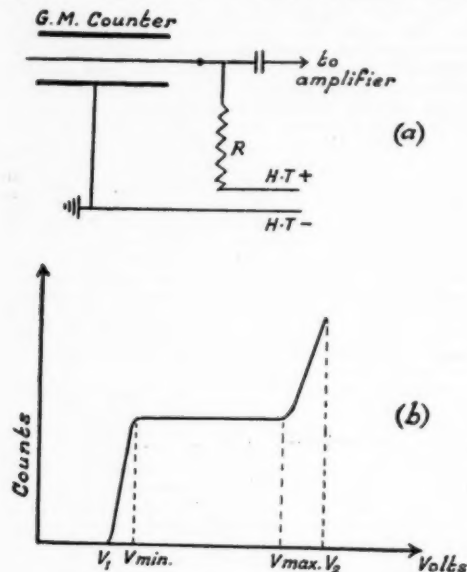


FIG. 1

place. In the absence of the resistance  $R$  (Fig. 1a), continuous discharge sets in as soon as the voltage is raised to  $V_{min.}$  It has been shown by Werner<sup>1</sup> that if a resistance  $R$  is introduced in the circuit, a permanent discharge can occur only if the voltage applied to the counter is greater than  $V_{min.} + I_{min.} \times R$  where  $I_{min.}$  is the minimum current required for a discharge and is characteristic of the counter under investigation.  $V_2 - V_{min.} = (I_{min.} \times R)$  gives a measure of the counting region. When the applied voltage lies between  $V_2$  and  $V_{min.}$  during a discharge the counter voltage falls below  $V_{min.}$ , and the discharge is interrupted. The voltage across the counter rises again to the full value of the high tension supply and the counter is ready for registering the next incoming particle. The region of constant rate of counting, i.e.,  $V_{max.} - V_{min.}$ , is only a part of the counting region. In order to have this region sufficiently large,  $R$  should be of the order of  $10^8$  to  $10^9$  ohms.

As is well known, the use of a very high resistance is rather a disadvantage in working with counters. Firstly the preparation of such resistances is not very easy. Secondly it sets a limit to the maximum permissible counting rate. After the passage of the discharge and the consequent fall in voltage across the counter, it is practically out of action for

a time  $t = t_d + t_{ro}$ , where  $t_d$  is the duration of the discharge and  $t_{ro}$  is the time taken by the counter for the voltage to rise above  $V_{min.}$  so as to make the counter active again. The time  $t_{ro}$ , depends on  $R$  as well as on the capacity of the counter and is of the order of  $10^{-2}$  sec. for  $R = 10^9$  ohms. The net result is that particles would be missed from being recorded at high counting rates. One way of avoiding this difficulty is to use a special circuit suggested by Neher and Harper.<sup>2</sup> In this the extinction is effected by a valve. Another way of avoiding most of the difficulties is to use a self-extinguishing counter which was first developed by Trost.<sup>3</sup> He showed that counters filled with argon and alcohol vapour had a reasonably wide counting range which was independent of the external resistance, and hence the resolving time could be made very small.

### 3. CONSTRUCTION OF BETA-RAY COUNTERS

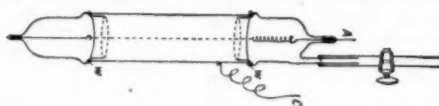


FIG. 2. Thin-walled Geiger-Muller counter

A = anode, C = Cathode, W = Wax seal

Thin-walled Geiger tube counters of the type shown in Fig. 2 were extensively used for measurements of  $\beta$ -ray activity. A thin metal tube of copper or aluminium (0.1 mm. thick) acted as cathode. In these counters the  $\beta$ -ray has to pass through the metal wall of the counter before it is detected. Due to the finite thickness of the wall, particles of energies below a certain value would be absorbed. Such counters are, therefore, not useful for measuring  $\beta$ -rays of low energy.

In order to measure the activity of substances emitting beta particles of low energy, the author developed some special types of counters. The most satisfactory one is shown

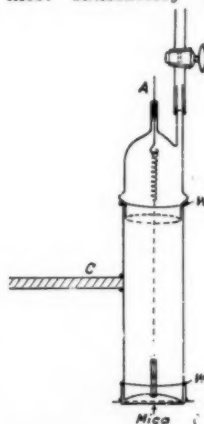


FIG. 3. Grid counter

in Fig. 3. This type was a slightly modified form of that used by Dr. Feather.<sup>4</sup> The coun-



ter was made up of a brass tube to one end of which was fixed a curved bridge with a hole in the middle. Through this hole passed a pyrex tube with a bead at one end. Into this narrow pyrex tube was fused one end of a piece of tungsten wire ( $50\mu$  in diameter). The other end of this wire was attached to a tungsten hook through a tungsten spring in order to keep the central wire under tension. The tungsten hook was fused to a pyrex glass cap which was fixed to the brass tube with picein wax as shown in the figure. That end of the brass tube which held the bridge was closed by means of a brass cap provided with a grid. A piece of thin mica film (2 cm. air equivalent) was stuck on the grid. With this arrangement the counter could be made vacuum tight and at the same time the beta particles could enter the counter through the mica window. The pyrex glass cap was provided with a side tube and a glass tap for purposes of evacuation and filling with gas. The counter was supported by means of a  $3/16$ " rod soldered to the body of the brass tube. The counter was usually mounted vertically with a standard adapter for specimen holders fixed at a defi-

radio-active sources could be removed from under the counter and brought back again exactly to the same position for counting.

Before assembly the parts of the counter were cleaned as follows:—The brass tube was well polished on the inside using the finest emery paper available and the dust from the inside was removed by running tap water under pressure through the tube. It was finally rinsed with distilled water and dried. The inside as well as the outside of the brass cap was well polished before fixing the piece of mica. The pyrex cap was cleaned by washing it with hot chromic acid and finally with distilled water. The  $50\mu$  tungsten wire which formed the anode was cut from a fresh spool, washed with benzene and alcohol and was heated to a dull red heat in a small flame. After assembly, the counter was evacuated and was filled with pure argon and absolute alcohol vapour in the ratio of 9:1 to make up a total pressure of 10 cm. of mercury. This ratio was first suggested by Trost.<sup>3</sup> A counter constructed on the lines indicated above gave a good characteristic with the counting region extending well over 300 volts.

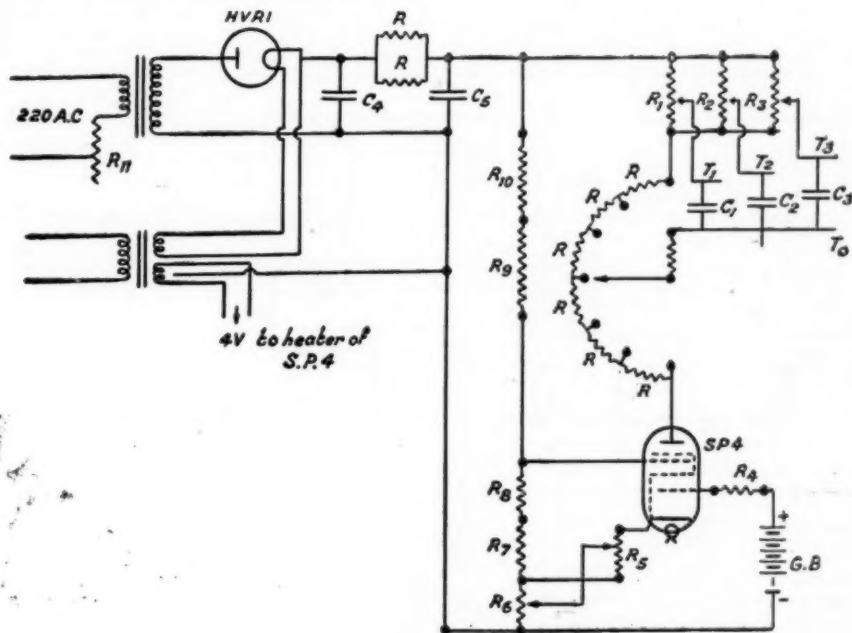


FIG. 4. Stabilised high tension unit for Geiger counters.

$R = 250,000$  ohms;  $R_1, R_2$  and  $R_3 =$  one Megohm each;  $R_4 = 2$  Megohms;  $R_5 = 25,000$  ohms (variable),  $R_6 = 15,000$  (variable);  $R_7 = 50,000$  ohms;  $R_8 = 100,000$  ohms;  $R_9, R_{10}, R_{12} =$  each one Megohm;  $R_{11} = 400$  ohms;  $C_1, C_2, C_3, C_5 =$  each  $0.1\mu F$ ;  $C_4 = 0.2\mu F$ .  $T_0, T_1, T_2$  and  $T_3 =$  output terminals.

nite distance from the former. The specimen holders were made of brass and were of the same standard size. They were provided with standard cups for holding the radio-active sample. The whole arrangement was such that the

4. HIGH TENSION UNIT  
A stabilised high tension unit with the output varying from 0 to 1,500 volts forms an integral part of any counting system using a Geiger counter. Many circuits using vacuum

tubes for stabilising the output voltage have been described in the literature. The circuit adopted by the author for the construction of the stabilised high tension supply was the one suggested by Lewis.<sup>5</sup> It is shown in Fig. 4.

It is a slightly modified form of Street and Johnsons' circuit.<sup>6</sup> The stabilisation of the output voltage was effected by a pentode.  $R_3$  was the standardising resistance. This, in conjunction with the bias battery, could be adjusted to give 1 mA. stabilised current so that each step on the range switch was equal to 250 volts and the control resistance,  $R_1$ ,  $R_2$  or  $R_3$  also covered about 300 volts. Stabilisation was made by adjusting  $R_3$ . The stabilising action could be tested by changing the input volts by varying the test stabilising resistance  $R_1$ , while measuring the output with an electrostatic voltmeter. The high tension supply was provided with three tappings coming from the three control resistances,  $R_1$ ,  $R_2$  and  $R_3$ . This was quite useful for doing work on double or triple coincidence. Three counters could be supplied with the necessary voltages from the same set, provided the operating potentials did not differ from one another by more than 250 volts.

#### 5. AMPLIFIER

The counter was coupled to a single stage amplifier as shown in the accompanying Fig. 5. The amplifier was both a single stage

and ses were reasonably sharp with an average resolving time of  $10^{-4}$  sec. The resolving time of the whole counting system was determined by the well-known coincidence method. Two identical counters were connected to two valves of the amplifier mixer circuit and two separate sources were placed under the counters. The two counters were well protected from each other so that the electrical impulses from one did not influence the working of the second one. The number of counts registered by each counter was recorded first and then the accidental coincidence rate was determined with and without the sources under the counters. The finite resolving time  $t$  of the counting set was calculated from the formula,<sup>7</sup>

$$A = 2 N_1 N_2 t + c$$

where  $A$  is the number of chance coincidences per sec.,  $N_1$  and  $N_2$  are the number of counts per sec. recorded by each counter separately and  $c$  is the number of coincidences due to penetrating radiations alone. The chance coincidence rate  $A$  was determined for various values of  $N_1$  and  $N_2$  and the finite resolving time  $t$  was evaluated from the above formula after eliminating  $c$ . The resolving time was less than  $10^{-4}$  of a second.

#### 7. EFFICIENCY OF THE COUNTING SYSTEM

Before using any counting system consisting of a Geiger counter, amplifier and the scale of eight for quantitative measurements, it is neces-

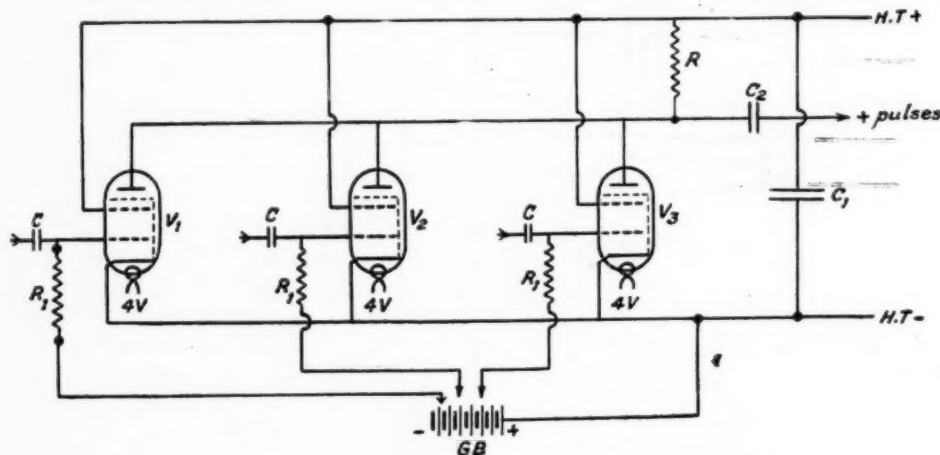


FIG. 5. Amplifier and Rossi mixer circuit for Geiger counters.

$R = 10$  Megohms;  $R_1 = 2$  Meg. ohms;  $R_3 = 30,000$  ohms;  $C_0 = 50 \mu F$ ;  $C_1 = 4 \mu F$ ;  $C_2 = 0.01 \mu F$ .

amplifier and a Rossi mixer circuit useful for coincidence work. It was mainly used as a single stage amplifier keeping the grids of the second and third valves heavily biased. The output from the amplifier was fed on to the discriminator of a thyatron scale of eight circuit.

#### 6. RESOLVING TIME OF THE COUNTING SET

The nature of the impulses produced in a good counter constructed as per details given in Section 3, was visually examined with the aid of a cathode-ray oscillograph. The impul-

sary to determine its overall efficiency. The efficiency of the recorder system used by the author was estimated by feeding in a known number of counts having a random distribution. Seven different capsules were taken, and into each was put some uranium oxide sufficient to give about 100 counts per minute. These capsules went into specified holes in a specimen holder which were marked 1, 2, ..... 7. Capsules, when used, were placed in their respective holes and counts given by each individually were determin-



ed. The calibrated sources were then used in combination and the sum of the individually determined values was taken as the true input. In this method the sources were so weak that the counting losses from any one source

TABLE I

Capsules	Count/min. observed	Counts/min. calculated	% Difference
1.....	84 ± 5		
2.....	128 ± 5		
3.....	106 ± 5		
4.....	140 ± 6		
5.....	110 ± 5		
6.....	171 ± 6		
7.....	108 ± 5		
1 2.....	209 ± 7	212 ± 7	-1.5 ± 1.5
1 2 3.....	315 ± 8	318 ± 8.5	-1 ± 3.5
1 2 3 4.....	440 ± 9	451 ± 10.5	-4 ± 3
1 2 3 4 5.....	573 ± 4	568 ± 12	+1 ± 2
1 2 3 4 5 6.....	726 ± 13	739 ± 13	-1.8 ± 2.5
1 2 3 4 5 6 7.....	873 ± 13	880 ± 14	-0.8 ± 2

were assumed negligible. Table I gives the experimental and the calculated values of the counts. The error for the sum was calculated from the formula  $e = (e_1^2 + e_2^2)^{1/2}$  where  $e_1$  and  $e_2$  were the errors in the two sets of counts when measured individually.

As would be evident from the table, for counts up to 900 per min. the efficiency of the counting system was very nearly 100 per cent.

The method was extended to higher counting rates. The seven capsules were filled with uranium oxide, each sufficient to give about 900

ciency steadily decreased and at 5,000 particles a min. the efficiency was about 95 per cent. When the number exceeded 7,000 a min., the mechanical meter attached to the scale of eight unit got jammed. The low efficiency of the counting system was due to the fact that the mechanical meter used was a very old and heavy one.

#### 8. COUNTER CHARACTERISTIC

A large number of counters of the type shown in Fig. 3 were constructed. The characteristic of a good one is reproduced in Fig. 6. Curve *a* represents the total counts, curve *b* the natural of the counter and curve *c* the net counts due to the radioactive source alone. Uranium oxide was used as a standard source. As would be evident from the curves, this counter had a flat portion extending from 950 to 1,250 volts over which the number of counts recorded remained constant. While taking measurements, this counter was usually worked at a potential of about 100 volts above the starting voltage. The counters with mica windows had a natural count varying from 20 to 40 per min. In most cases the natural was not affected by bringing a strong source for measurement. In order to check whether the counter was behaving properly, the natural of the counter and also the strength of a standard uranium source were measured at frequent intervals. The characteristics of counters with mica windows, if properly made, remained satisfactory for periods extending over a year or more.

The effect of the partial pressures of argon and alcohol on the counter characteristic was studied and the best characteristic was obtained when the partial pressures of argon and alcohol were in the ratio of 9:1. The value of the quenching resistance was found to have no appreciable effect on the characteristic of a counter filled with argon and alcohol, although it affected the size of the pulse transferred to the amplifier. These results were in accordance with the observations reported by Trost<sup>3</sup> and Curran and Petrzilka.<sup>8</sup> It was found that if the pyrex glass cap was replaced by a cap of soft glass, spurious pulses were recorded due to electrical leaks.

#### 9. SOFT $\beta$ -RAY COUNTERS

Radioactive isotopes having very long periods are in general very weakly activated, and the radiations emitted by them are often very soft. An ordinary counter in which the particles have to pass through a mica window of thickness equivalent to about 3 cm. of air, before entering the counter is not very efficient for detecting and studying the soft radiations emitted by weak radioactive bodies. A special type of counter suitable for the study of the soft  $\beta$ -ray spectra was constructed by Libby and Lee.<sup>9</sup> Two types of soft counters of simple design were constructed by the author, one of which was used for detecting and measuring the half periods of radioactive isotopes, while the second was employed for the measurement of absorption in aluminium of the radiations emitted. In both the types the active substance was placed inside the counter.

The counter of the first type is shown in Fig. 7. It is substantially the same as that

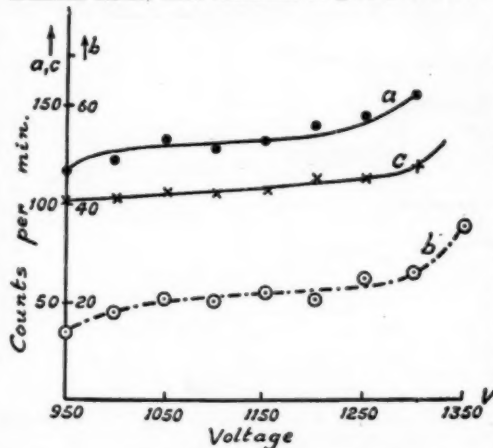


FIG. 6. Characteristic of a Geiger counter counts per min., and the experiments were repeated. It was found that with the counting system used by the author, the losses became appreciable when the number of particles counted exceeded 2,000 a min. The counting effi-

shown in Fig. 3. Instead of the grid cap it was provided with a glass collar and a ground-in stopper which carried the specimen holder. After inserting the active substance into the

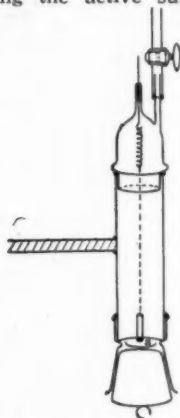


FIG. 7. Soft  $\beta$  ray counter. S = specimen holder.

counter, it was evacuated and filled with the required amount of argon and alcohol. The absorption was almost negligible inside. In a counter of this type the natural characteristic had to be determined beforehand. After inserting the substance and filling the counter with argon and alcohol, the counter potential was set at the predetermined value, and the activity was measured. The chief drawback in counters of this type was that the natural, the counts due to some standard source and the counts due to radioactive sample under examination could not be measured simultaneously without opening the counter, evacuating and filling it

The defect mentioned above was, however, eliminated by adopting the following modification in the construction of the counter. The counter part was housed on a side tube attached to the middle portion of a wide glass tube about 9" long. One end of this tube was drawn out and fused, while the other end was closed by means of a rubber stopper. A steel rider slid along a rod which was fixed axially inside the wide glass tube. The rider was four inches long and at its two ends were fixed two specimen holders, one for the radioactive sample under investigation and the other for a standard source. The rider could be moved along the rod by means of an electromagnet. By placing the rider symmetrically below the counter, its natural was determined. The reliability of the counter was checked by taking measurements with the standard source at frequent intervals.

For absorption measurements of very weak radiations either soft  $\beta$ -rays or soft X-rays, the counter shown in Fig. 8 was developed by the author. The counter part was similar to that shown in Fig. 2 with the difference, namely, that the cathode cylinder was made of fine copper gauze. The counter was mounted horizontally inside a pyrex bell-jar. The glass cap of the counter was fitted into the side tube which held the counter in position. The radioactive preparation was placed inside a specimen holder, S, which was fixed to the stop-cock. Aluminium absorbers were mounted on a drum which was provided with sufficient number of apertures. The drum was capable of rotation by means of a handle, H, which could be operated from outside. A paper scale was fixed on the drum and a mark was made on the top of the bell-jar. By turning the handle, H, and noting the position of the mark on the scale, any particular absorber could be brought over the source. One of the absorbers

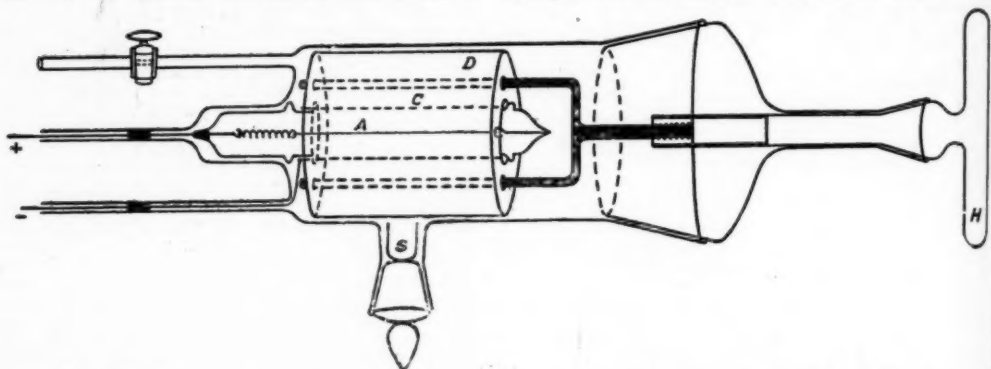


FIG. 8. Demountable soft  $\beta$ -ray counter. A = anode, C = cathode; D = drum containing the absorbers; S = specimen holder and H = handle for rotating the drum.

every time with alcohol-argon mixture. It was found that if sufficient care was taken in letting in dust-free air and if the counter was not unduly exposed to the atmosphere, the natural as well as the characteristic of the counter could be reproduced within the limits of experimental error.

was of lead with a thin aluminium foil over it. The thickness of the lead foil was such that it was capable of effectively cutting off soft X-rays and the aluminium foil over it would absorb the photo-electrons ejected from the lead absorber. The specimen holder was in the form of a tall cylindrical box and the size of the

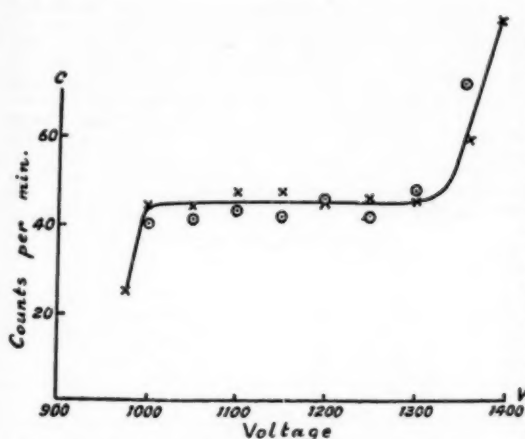


FIG. 9. Characteristic of a demountable soft  $\beta$ -ray counter. Circles—when the counter was first assembled. Crosses—after two months of use. The drum was such that the absorbers formed a cover for the specimen holder. This prevented

the particles emitted by the radioactive source getting away through the sides and finally finding their way into the active region of the counter and giving spurious results. The cylindrical form also helped to canalise the particles.

A counter constructed on the lines indicated above worked quite satisfactorily and its characteristic is shown in Fig. 9. This counter was successfully used for measuring the absorption in aluminium of the soft electrons emitted by the 6.7 hr. and 1 year cadmium isotopes.

1. Werner, *Zeits. f. Phys.*, 1934, **90**, 334, 1934, **92**, 705.
- Henning and Schade, *Zeit. f. Phys.*, 1934, **90**, 597.
2. Neher and Harper, *Phys. Rev.*, 1936, **49**, 940.
3. Trost, *Zeit. f. Tech. Phys.*, 1935, **16**, 407. *Phys. Zeit.*, 1935, **36**, 801. *Zeit. f. Phys.*, 1937, **105**, 399.
4. Feather, *Camb. Phil. Soc. Proc.*, 1938, **34**, 115.
5. Lewis, *Journ. Sci. Instruments*, 1938, **15**, 353.
6. Street and Johnson, *Journ. Frank. Inst.*, 1932, **214**, 155.
7. Feather and Dunworth, *Proc. Roy. Soc. (A)*, 1938, **168**, 566.
8. Curran and Petzlik, *Proc. Camb. Phil. Soc.*, 1939, **35**, 309.
9. Libby and Lee, *Phys. Rev.*, 1939, **55**, 245.

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## TTT-CURVE DATA AND THEIR APPLICATION

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SINCE the publication of the original paper by Davenport and Bain<sup>1</sup> in 1930 much interest has been shown by metallurgical workers in the study of isothermal transformation of austenite. Investigation on the effect of alloying elements and the nature of austenite on the position of the S-curve have added to our knowledge of the mechanism of the kinetics of the transformation in austenite. The original steels investigated by Davenport and Bain<sup>1</sup> gave curves of such a shape as to suggest the term S-curve for this type of isothermal transformation. Since then, alloy steels have been investigated in which there

are three temperature ranges of rapid transformation, instead of two as on the plain carbon steels, and those are not in any way suggestive of the letter 'S'. Figs. 1 and 2 respectively

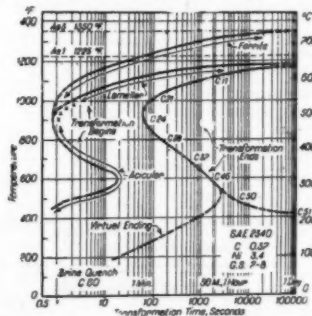


FIG. 1. Isothermal transformation curve for S. A. E. 2340 steel (Ref. 6).

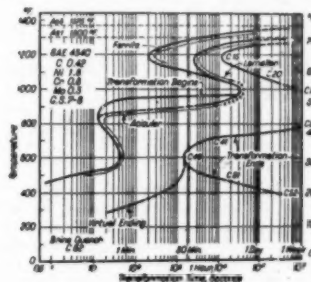


FIG. 2. Isothermal transformation curve for S. A. E. 4340 (Ref. 6).

show these two types of curves. The term "isothermal transformation diagrams" and "TTT-curves" (time-temperature-transformation curves) also have the same meaning as the term S-curve. The term TTT-curve has been adopted in this contribution.

This paper is prepared with a view to assembling important features on TTT-curves and their applications and interpretation. The purpose has been to indicate its applicability in heat treatment of steels,

## DETERMINATION OF TTT-CURVES AND THEIR CHARACTERISTICS

The TTT-curve for a steel records the time taken for the beginning and ending of the decomposition of austenite at any sub-critical temperature. Due to the fact that a wide range of times are required, it is necessary to plot the results with a logarithmic time scale and linear temperature scale, so that details for the short periods can be clearly indicated.

A TTT-curve may be determined in various ways. The methods that have been employed include microscopic and dilatometric determinations,<sup>1</sup> electrical resistivity,<sup>2</sup> and magnetic induction measurements.<sup>3</sup> Of the methods mentioned the microscopic yields data which are easily interpreted. The method consists in (a) transforming small steel samples into austenitic condition, (b) transferring them to a liquid bath maintained at a temperature under study for various lengths of time, and (c) quenching to room temperature. The samples are then polished and etched for microscopic examination which indicates when visible transformation has taken place. The untransformed portion of austenite left over at the end of the time in the liquid bath is transformed to martensite by quenching to room temperature. A partially transformed sample would thus consist of a mixture of a product characteristic of the holding temperature and some martensite.

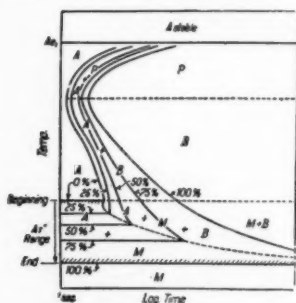


FIG. 3. Modified TTT-curve Full lines represent per cent. austenite transformed (Ref. 5). A—Austenite; P—Pearlite; B—Bainite; M—Martensite.

The original TTT-curve of Davenport and Bain<sup>1</sup> suggested that the products of transformation of austenite could result isothermally. However, the work of Greninger and Troiano<sup>4</sup> indicates that the change of austenite to martensite could not be an isothermal reaction but occurred instantaneously on cooling below a certain temperature known as "M" point. Accordingly, the presentation of the lower part of the TTT-curve (Fig. 3) had to be changed, as suggested by Cohen. Since the work of Davenport and Bain many investigators<sup>6,7,8</sup> have studied steels by the isothermal method.

## FACTORS INFLUENCING THE POSITION OF TTT-CURVE

Certain precautions are essential in the application of data from TTT-curve.

For a steel of given chemical composition the outline of the TTT-curve can vary over a wide range, dependent upon the condition of austenite prior to quenching. The condition of the austenite in relation to hardenability can be defined in terms of the "as quenched" austenite grain size and the degree of solution of the carbides. Roberts and Mehl<sup>9</sup> in their paper on the influence of inhomogeneity of austenite on the rate of austenite-pearlite reaction have shown that the undissolved carbides not only reduce the effective carbon content, but also work as nuclei for the formation of pearlite. The influence of undissolved carbide on the position of the curve is illustrated in Fig. 4.

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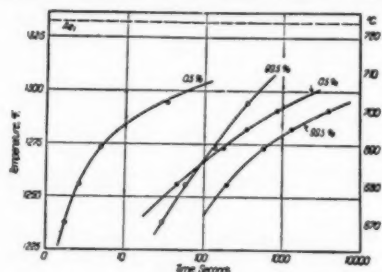


FIG. 4. TTT-curves for reaction from homogeneous austenite are shown by pair of curves at right, and from austenite containing undissolved carbide are shown by the pair of curves at left. These curves are for eutectoid steel (Ref. 18).

The effect of alloying elements on the isothermal portion of TTT-curve was studied by Davenport<sup>6</sup> in 1939. It was observed that all the common elements studied, except cobalt, shifted the TTT-curve toward the right. The influence of alloying elements on the "M" point (Martensite transformation point) has been determined by Greninger,<sup>10</sup> and by Payson and Savage.<sup>11</sup> The latter suggested the following equation to determine the effect on "M" point:  $M (^{\circ}F) = 930 - 570 C - 60 Mn - 50 Cr - 30 Ni - 20 Si - 20 Mo - 20 W$ , where the elements are given as

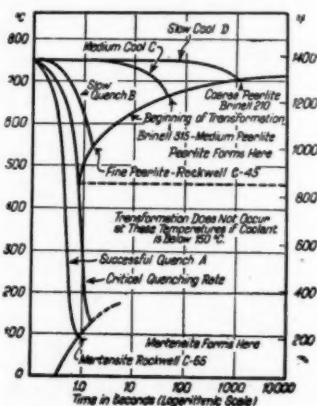


FIG. 5. Schematic representation of relation between cooling rate and temperature of initial transformation for carbon steel (Ref. 6).



per cent. by weight. Although the equation is not precise, the results obtained in most instances are satisfactory for practical application.

It is important that, in order to apply quantitatively the isothermal data, the steel should undergo transformation at constant temperature so as to satisfy the conditions under which the original diagram is prepared. Further, the engineer must ascertain that the condition of austenite and chemical composition are identical with those of the steel from which the isothermal curve is determined.

#### COOLING DIAGRAMS

For practical purposes the engineer should be able to predict the transformation products that will be obtained on continuous cooling of the work. This necessitates a relationship between isothermal transformation data and the continuous cooling data. A schematic cooling diagram showing the structures produced by several cooling rates is shown in Fig. 5.

The diagram indicates the changes of steel S.A.E. 2340 whose TTT-curve is shown in Fig. 1, in which either pearlite or martensite is produced, dependent upon the critical cooling rate. In this case no bainite is formed as it is sheltered by "nose" (point where the tangent to the beginning line of the TTT-curve is parallel to the temperature axis). In high alloy steels, however, it may be possible to exceed the critical cooling rate in the pearlite range and yet cut the second "nose" as shown in Fig. 2 during subsequent cooling, so that some bainite may be formed.

Grange and Kiefer<sup>12</sup> developed an empirical method of deriving a continuous cooling transformation diagram from the conventional transformation data (Fig. 6), and showed that the calculated curve agreed closely with experimental data obtained on continuous cooling. Grange and Kiefer made the following two basic assumptions:

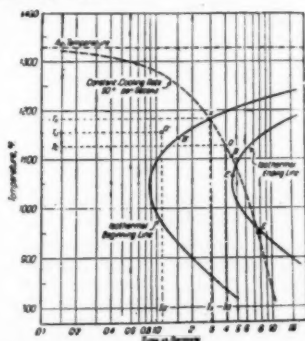


FIG. 6. Diagram showing a portion of the isothermal transformation figure for plain carbon eutectoid steel and a constant cooling rate of 50 deg. F. per second plotted from  $A_{e1}$  temperature (Ref. 12). This diagram illustrates the steps involved in the method for relating transformation on cooling to the isothermal figure.

- (1) That "the extent of transformation of the austenite at the instant it cools to the intersection point (Fig. 6) is not sub-

stantially greater than it would have been if quenched instantly to  $T_x$ ; in other words, some additional cooling time will be required before any measurable transformation occurs, in all cases of practical interest."

- (2) That "on cooling through a limited temperature range, for example,  $T_x$  and  $T_o$ , the amount of transformation is substantially equal to the amount indicated by the isothermal diagram at the mean temperature  $\frac{1}{2}(T_x + T_o)$  after a time interval  $t_x - t_o$ ."

Assumption (1) implied that when the work cooled to point X (Fig. 6), austenite has hardly decomposed, so that it is necessary to hold at this temperature  $T_x$  almost as long as  $t_x$ . This condition is, however, more nearly approached with decreasing slope of the upper position of the isothermal transformation figure and with the fall in cooling rate.<sup>13</sup>

Assumption (2) is also strictly applicable when the period of nucleation is independent or varies as the first power of the temperature. Experience has shown that the assumptions are justifiable as the method gives satisfactory results.

One of the salient features of the above method of deriving a continuous cooling transformation curve is that all times are recorded from the A temperatures, since only the undercooling of austenite is effective in starting transformation process. Times after passing the  $A_{e1}$  are used for consolidating the transformation of pro-eutectoid ferrite or carbide; and times after passing the  $A_{e2}$  when considering transformation of pearlite or bainite. Diagram of S.A.E. 4340 prepared after Grange and Kiefer is shown in Fig. 7.

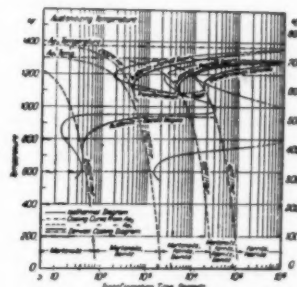


FIG. 7. Diagram showing austenite transformation on cooling at constant rate in S.A.E. 4340 steel (Ref. 12). This diagram was derived from isothermal data.

Steinberg<sup>13</sup> also developed a method of deriving cooling diagrams from isothermal transformation diagrams. Steinberg's method is more theoretical and takes into consideration the induction period of nucleation at all sub-critical temperature levels whereas in the Grange and Kiefer method the nucleation periods are taken into account from the point where the cooling curve intersects the TTT-curve.

In addition to giving a satisfactory answer to austenite transformation on continuous cooling,

TTT-curve introduced many new methods of heat treatment, or variations of older ones, which are briefly surveyed.

#### AUSTEMPERING

Austempering is applied when bainite is desired in a low alloy high carbon steel. The steel is quenched from austenizing temperature in a liquid salt or metal bath maintained at some sub-critical temperature. It is important to bear in mind that the cooling velocity of the piece must be great enough to miss the "nose" of the TTT-curve (Fig. 8), thereby

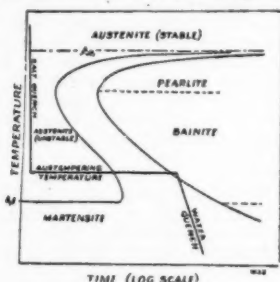


FIG. 8. Schematic diagram illustrating austempering (Ref. 19).

avoiding the formation of very fine pearlite. The work is kept immersed in this constant temperature bath until transformation is over. Although the work could be austempered at any temperature in the bainite zone, that is, just below the "nose" of the TTT-curve to the "M" point, the superiority in toughness of austempered structures over quenched-tempered structures of the same hardness is obtained only on the range of about 395 to 595 Vickers pyramid hardness (Rockwell "C" 40 to 55).

The above method is applicable to small sections as they could be cooled rapidly enough to avoid formation of pearlite at the centre. When alloying elements are added, the "nose" of the TTT-curve is shifted to the right resulting in increased transformation times in the bainite range. This restricts the amount of alloying elements that can be added for economical operation.

Attempts have been made to increase the size of the work that can be successfully austempered. One of the methods is to withdraw heat rapidly by quenching the section for a very short interval into oil or water at room temperature, before transferring to a liquid lead or salt bath. The main objection to this method is that deleterious stresses are developed. Another method proposed by Elmendorf<sup>14</sup> consists of cooling the whole work to a definite temperature below the "M" point to produce a certain amount of martensite throughout the work, and re-heating to a sub-critical temperature to transform the remaining austenite and temper the martensite. The structure produced comprises a mixture of bainite and tempered martensite.

#### MARTEMPERING

Martempering was developed by Shepherd<sup>15</sup> and is designed to minimize the development of internal stresses on quenching large objects,

The process (Fig. 9) consists in first quenching the object at a rate greater than the critical to a point slightly above the "M" point and

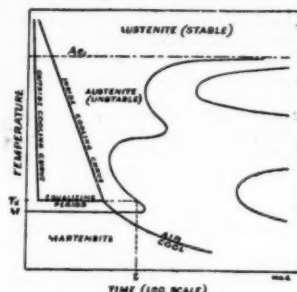


FIG. 9. Schematic diagram illustrating martempering (Ref. 19).

held there until thermal gradients vanish. The object is then allowed to cool in air. Such slow cooling minimizes the thermal gradient, so that martensite forms evenly throughout the object. The percentage of martensite developed depends upon the degree of cooling below the "M" point. If products other than martensite are to be avoided the work should be held above the "M" point for a period shorter than "t" at temperature  $T_x$ . For developing proper hardness the object can be tempered further.

#### ISOTHERMAL ANNEALING

Isothermal annealing was comprehensively studied by Payson<sup>16</sup> and is schematically shown in Fig. 10.

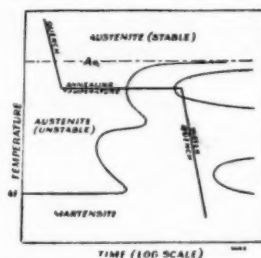


FIG. 10. Schematic diagram illustrating isothermal annealing (Ref. 19).

This process enables a considerable saving of time and is economical. For instance, annealing cycles of steels possessing high hardenability are so long that the treatment sometimes becomes uneconomical. A study of TTT-curve will, however, show that generally there is a minimum time for complete transformation at about 1200° F. It is, therefore, obvious that annealing at this optimum temperature can be carried on by isothermal transformation with less time and expense. It is important that this temperature range of minimum transformation time is sometimes very narrow, and must therefore, be determined with great care. The microscopic method is suitable for this determination,



It may further be pointed out that variation in early structures and austenizing treatments shift the TTT-curve so that the optimum temperature of transformation may vary appreciably for any steel.<sup>9</sup> Therefore, laboratory determinations of TTT-curves should be undertaken on material under identical conditions of early structure and austenizing as employed in the plant.

Despite the simplicity of TTT-curve, it must be remembered that this curve is always determined under specific conditions. According to Mehl<sup>18</sup> the following factors affect the position of TTT-curve:—

1. Variations in grain size.
2. Variations in composition.
3. Variations in carbide solutions.

Any variation in the above conditions must be accounted for in applying the data.

1. Davenport, E. S., and Bain, E. C., *Trans. A.I.M.E., Iron and Steel Division*, 1930, **90**, 117. 2. Rote, F. B., Turckenmiller, W. C., and Wood, W. P., *Trans. A.S.M.*, 1942, **30**, 1359. 3. Charles Nagler and William P. Wood, *Ibid.*, 1942, **30**, 491. 4. Greninger, A. B., and Troino, A. R., *Ibid.*, 1940, **28**, 537. 5. Cohen,

M., See discussion to above reference No. 4. 6. Davenport, E. S., *Trans. A.S.M.*, 1939, **27**, 837. 7. Blanchard, J. R., Parke, R. M. and Herzig, A. V., *Ibid.*, 1943, **31**, 849, and *Ibid.*, 1941, **29**, 317. 8. Gordon, P., Cohen, M., and Rose, R. S. *Ibid.*, 1943, **31**, 161. 9. Roberts, G. A., and Mehl, R. F., *Trans. A.I.M.E.*, 1943, **154**, 318. 10. Greninger, A. B., *Trans. A.S.M.*, 1942, **30**, 1. 11. Payson, P., and Savage, C. H., *Ibid.*, 1944, **33**, 261. 12. Grange, R. A., and Kiefer, J. M., *Ibid.*, 1941, **29**, 85. 13. Steinberg, S. *Metallurg.*, 1938, **13**, (97). 14. Elmendorf, H. J., *Trans. A.S.M.*, 1944, **33**, 236. 15. Shepherd, B. F., *Iron Age*, Feb. 4, 1943, 45; 1943, Jan. 28, 50. 16. Payson, P., *Ibid.*, 1943, **151**, No. 25, 47; 1943, **152**, No. 1, 48; 1943, **152**, No. 2, 14; 1943, **152**, No. 3, 70; 1943, **152**, No. 4, 60. 17. Roberts, G. A., and Mehl, R. F., *Trans. A.I.M.E.*, 1943, **154**, 318. 18. Mehl, R. F., *Trans. A.S.M.*, 1941, **29**, 813. 19. Cunningham, R. L., and Arthur Dubey, *Canadian M. and Met. Ind.*, 1944, **7**, No. 7, 22.

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## EFFECT OF AFTERNOON HEAT LOWS ON WINDS AT LOWER LEVELS

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(Poona)

THE question of diurnal variation on surface winds has been discussed elsewhere.<sup>1</sup> Mention was made of the large variation of winds at Ahmedabad on many days in winter even in upper air. On many mornings in late winter, the upper winds at Ahmedabad are N.W. or N.E., and have a speed of nearly 30 m.p.h. up to about 1.5 km. above m.s.l. But in the afternoon the wind speed drops down to as low a value as 5 m.p.h. An explanation can be easily given once the fact is known. When one of the low pressure areas of a western disturbance is approaching Kathiawar or south Rajputana, the seasonal high pressure area to the west of Ahmedabad gets intensified and gives rise to strong winds with some northerly direction. The strength of the seasonal high diminishes with height at the place. The more northerly low pressure areas of the western disturbance also limit the extent of the high pressure area. The vertical extent of the strong winds is, therefore, limited by the above considerations to about 1.5 km. The intensification of the high pressure leads to clear afternoon skies giving full play to solar heating. A low pressure area due to this solar heating is superimposed in the afternoons diminishing the strength of the high pressure area, and consequently the strength of the upper winds. The vertical extent of the heat low is also of the same order as 1.0 to 1.5 km. so that the diurnal variation of upper winds is most marked in this layer.

An equally remarkable diurnal variation can be observed at Mandalay in Upper Burma, in the clear season, i.e., in the non-monsoon months. The upper winds up to about 1.5 km. show in the mornings large southerly components. But in the afternoons the southerly com-

ponent diminishes very considerably. Sometimes even a small northerly component may actually be seen. The following table is based on an average of five to six years.

TABLE I  
Components from South (miles per hour)

Height	March		April		May		October	
	M	A	M	A	M	A	M	A
0.5 km.	12.3	-1.3	16.5	2.7	21.4	5.8	7.8	-1.1
1.0 km.	5.6	-0.2	12.8	2.9	18.0	5.6	5.6	+0.2

M—Morning.

A—Afternoon.

The approximate location of the semi-permanent low pressure areas was derived from considering the fact that the low pressure areas are regions of upward convection. In the sunny afternoon near the hills or uplands, instead of the Katabatic winds uphill currents of Anabatic winds occur.<sup>1</sup> In the uplands or near the hills, the afternoon convection or upward air motion is greater than in the neighbouring plains. In other words, the uplands or hills behave as areas of low pressure. It is well known that the reduction of barometric pressure to the sea level or the neighbouring plain level shows on sunny days a relative low pressure area over the hills or the uplands. It may be thought that the effect of this has little significance. The winds at upper levels are determined not only by the pressure gradient but by the density of air which is dependent on the temperature distribution. The apparent low introduced by reduction of barometer is also

due to the deviation of the temperature distribution from an assumed value. When it is possible to work out these equations more rigorously, one can confidently expect that these apparent low pressure areas in the afternoon have their value in determining the winds.

Because of the orography of Upper Burma, there should be a semi-permanent low pressure area west of Mandalay as a feature in the dry season. As an afternoon effect a low pressure area should be superimposed due to Shan Hills. This superimposed low pressure area would be to the east of Mandalay, and would give rise to northerly winds which diminish the southerly components found in the mornings.

A further application of the afternoon low pressure areas over the hills can be made to explain the "Sea Breeze" to the east of Western Ghats in Peninsular India. Rice, in the *Gazetteer of Mysore*, mentioned long ago that sea breeze blows at Shimoga. It is known to occur in Hassan and Belgaum districts. Ramnathan<sup>3</sup> studied the sea breeze at Poona, but gave no explanation for its penetration so far from the coast.

It is generally considered that the sea breeze is due to differential heating of coastal land and sea. It is supposed to flow across the isobars for a distance not exceeding 15 to 20 miles inland. The depth of the sea breeze is also not great. But the places east of the Western Ghats are much farther away. There is a high range of hills with an average height of 2,000 to 3,000 feet between the sea and these places. One would have thought this as an obstruction across which the sea breeze would not penetrate. The sea breeze does not penetrate so far inland in the flat coast north of Bombay.

The author pointed out<sup>1</sup> that the wind at a place near the sea or hills is the resultant of the synoptic wind, i.e., wind due to the prevailing circulation of the day and the effects of sea and land breezes, Katabatic (down hill) and Anabatic (up hill flow) winds. The sea breeze which flows across the north Konkan coast is accelerated by the heat low lying adjacent to the Ghats. Once the isobaric picture has been drawn carefully and completely, the idea of orography or the hills obstructing the flow should not again be considered. At the obstacle, the equations may not prove correct. But on either side of the obstacle or the range of hills, the wind given would be correct (cf. barrier equations in hydrodynamics and other similar subjects). The sea breeze which is accelerated by the heat low would blow much further inland than if the low did not exist. Because of momentum gained the wind would cross the central axis of the low due to the Western Ghats, until friction and pressure gradient against it wipe it out.

For the occurrence near the hills, it may be argued also in a slightly different and more easily understandable way. The sea breeze that reaches the foot of the hills on the western side of the Ghats is carried along with the uphill wind (Anabatic wind) to a higher height and allows the stream to cross the Ghats. As the time of maximum temperature is usually past by the time the wind reaches the top of the Ghats, the resultant wind flows down on the eastern side till its momentum is exhausted. There is absolutely no difference between this and the statement in the last paragraph, except that of a physical picture.

It is possible that the above offers an explanation to the strong westerly winds which blow in the summer afternoons in the plains of the United Provinces and the adjoining regions. At other hours, the wind strength dies down considerably. The morning isobaric picture is an increase of pressure to the north extending to the plateau of Tibet. Even in the afternoon charts, the pressure increases towards the north in the plains of the United Provinces. In fact, there is an afternoon heat low over the Peninsula. Due to the latter, one should have expected the winds to have some easterly direction. The fact that the winds blow W. or W.N.W. shows that in the summer afternoons, an apparent low must be forming and being superposed to the north of the United Provinces. As in the case of the Shan Hills, the apparent low must be forming over the Himalayas and the Tibet. The reasons for the formation of the low must be the same as before. The uphill currents must give the effect of a low, or the pressure and temperature distribution must both be responsible for the effect on the wind. The reduced barometer readings of Roorkee show a higher pressure than the corresponding values for Dehra Dun on summer afternoons though, in the mornings, the opposite is the case. The stations are chosen near each other so that only diurnal effects are shown up. An analysis may be made to divide the winds into one due to pressure gradient and the other due to the temperature gradient (Thermal winds) after laborious investigations. The picture in this paragraph is simple and can be applied in other similar cases. A confirmation of the above can be seen when there is a western disturbance passing at a more northerly latitude, the afternoon winds in the United Provinces are stronger than usual.

1. *Tech. Note No. 19, Indian. Met. Dept., 1945.*
2. —, No. 20, *Ibid.*, 1945. 3. *Sci. Notes, Indian. Met. Dept., 1931, 3, 131.*

*Note.*—The cost of printing this article has been met from a generous grant-in-aid from the Indian Council of Agricultural Research, New Delhi.

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## THE HOTTER THE SUN, THE COOLER THE EARTH

It has been known for a long time that the average temperature of the earth as a whole varies inversely as the frequency of sunspots. Humphreys<sup>1</sup> has expressed this fact by the paradox: "The hotter the sun, the cooler the earth". Although he<sup>2</sup> has indicated an explanation, he<sup>1</sup> concludes that the cause cannot be determined without further observation.

The author<sup>3</sup> has studied the relationship between the average annual sunspot numbers and the pressure distribution in the neighbourhood of South America during April and May. He assumes a sine-curve to represent the normal latitudinal distribution of pressure and finds significant correlation (5 per cent. level) between sunspots and the amplitude of the curve. He finds that the amplitude of the normal pressure profile in the South Atlantic decreases with increasing sunspots. Since a strengthening of the meridional circulation should increase the convection and subsidence near the equator and in the horse-latitudes respectively, and hence increase the pressure gradient from the equator to Lat. 30°, a decrease in the amplitude implies a weakening of the meridional circulation. Again, since a decrease in the amplitude of the pressure profile means a decrease in the pressure gradient between the high pressure area at Lat. 30° and the low pressure areas at the equator at Lat. 60°, that also implies a weakening of the westerlies of the higher latitudes and the easterlies of the equatorial zone. But a weakening of the easterlies near equator means an increase in the absolute wind strength

in that region. Therefore during sunspot maxima (i) the meridional circulation weakens and (ii) the energy of the atmosphere is increased in the equatorial zone and decreased in the higher latitudes. It could be easily seen that (i) and (ii) are mutually balancing factors in the general atmospheric circulation.

Now, during sunspot maxima the meridional circulation weakens and, therefore, the transport of heat to higher latitudes becomes less. Hence there should be excess of heat in the equatorial zone and less of it in the higher latitudes. This effect is already noticed to co-exist even from a consideration of variation of the amplitude. The excess of heat that should thus be available in the equatorial zone will strengthen the zonal circulation (absolute wind velocity increases) as well as increase convection in the region. The latter will increase the cloud amount and ward off insolation. Thus due to a weakening of the meridional circulation during sunspot maxima, the temperature in the higher latitudes will be reduced and that near the equator cannot increase appreciably. Therefore the average temperature of the earth is reduced.

However, further work has to be done before establishing the relationship between the meridional circulation and the sunspots.

Poona,

K. S. RAMAMURTI.

December 30, 1947.

1. Humphreys, W. J., *Physics of the Air*, McGraw Hill Book Co., Inc., New York and London, pp. 619-21, 1940. 2. —, *Astrophys. J.*, 1919, 32, 97. 3. Ramamurti, K. S., *Indian Sci. Congress*, 1948.

# THE C-C FORCE CONSTANT IN CYCLO-OCTA-TETRAENE (C<sub>8</sub>H<sub>8</sub>)

THE structural formula of this important substance is not definitely known. According to Richter,<sup>1</sup> though its formula seems somewhat similar to the Kekule formula for benzene, it is very unlike benzene and displays a strongly unsaturated and distinctly aliphatic character. Recently Fleet and collaborators<sup>2</sup> have studied the Raman and infra-red spectra and are inclined towards the D<sub>2d</sub> cradle type structure. On the other hand, Bastiansen and others<sup>3</sup> have also studied the electron diffraction, besides the Raman spectra, and suggest D<sub>4d</sub> structure with equivalent C-C bonds nearly 2 per cent. greater than those in benzene, and the C-C-C angle of 120°.

Bhagavantam and Venkatarayudu<sup>4</sup> have obtained the frequencies of the S<sub>g</sub> molecule which possesses a D<sub>4d</sub> = S<sub>8H</sub> structure. Since the structure of the molecule as given by Bastiansen and co-workers<sup>3</sup> is also the same, we have utilized their formulae for calculating the force constants and the ring frequencies of the molecule. Using the force constant of the C-C bond as  $5.765 \times 10^5$  dynes and that of C-C-C deformations as  $0.165 \times 10^{-11}$  dynes, the calculated ring frequencies and the observed ones<sup>5</sup> are as shown (R refers to Raman, and I.R. to infra-red frequencies).

TABLE I  
Calculated and Observed Ring Frequencies  
of Cyclo-Octa-Tetraene

Calculated	200	880	292	983	166	456	1148	111	1456	235
Observed	200	876	292	944	166	370	1209	111	1442	254
	(8)	(8)		st.		(6)	(6)		(6)	(3)
Selection rule	R	R	I.R.	I.R.	I.R.	R	R	R	R	R

There is fairly good agreement between the observed and the calculated values so far as the Raman spectrum is concerned, and this suggests that the force constants are of the right magnitude.

The force constant 'Ke', the C-C distance 'Re' and the C-C bond order in various carbon compounds are as shown.<sup>5,6</sup>

TABLE II  
The 'Ke', 'Re' and Bond Order of Carbon  
Compounds

	C-C	C=C	C≡C	C-C (Benzene)	C-C (Octa-tetraene)
'Ke'	4.0	9.5	15.6	7.5	$5.765 \times 10^5$
'Re'	1.54	1.34	1.22	1.39	$1.45 \times 10^{-8}$
Bond order	1	2	3	1.66	1.3
Dissociation energy	3.6	6.46	8.7	5.5	4.6 ev.

The C-C distance in cyclo octa-tetraene has been obtained by the use of Allen Longair's relation,<sup>7</sup>  $Ke \times Re^6 = C_1$ , and the dissociation energy 'D' with the help of Sutherland's relation,<sup>8</sup>  $D = c_2 Ke \times Re^2$ . The values of  $c_1$  and

$c_2$  found with the help of the data in columns (1) to (4) are 53 and 0.38 respectively. The calculated value of the C-C distance, 1.45 Å, is fairly close to the observed value, 1.42 Å. It is also seen that there is an almost linear relationship between the bond order and the dissociation energy, and this gives the bond order in octa-tetraene to be 1.3.

The calculated values of the C-C force constant and the bond order both indicate that the substance possesses a distinctly aliphatic character. These calculations also lend support to the D<sub>4d</sub> structure suggested by Langseth.<sup>3</sup> A fuller investigation is in progress.

Department of Physics,  
University of Allahabad,  
January 1, 1948.

B. D. SAKSENA.  
HARI NARAIN.

1. Richter, *Chemistry of Carbon Compounds*, 1939, 75.
2. Fleet, Cave, Vago, Thompson, *Nature*, 1947, 159, 739.
3. Bastiansen, Hassel, Langseth, *Ibid.*, 1947, 160, 128.
4. Bhagavantam and Venkatarayudu, *Proc. Indian Acad. Sc.*, 1938, 8, 101.
5. Slater, *Introduction to Chemical Physics*, 1939, 433.
6. Hertzberg, *Infra-Red and Raman Spectra of Polyatomic Molecules*, 1946, 193.
7. Allen and Longair, *Phil. Mag.*, 1935, 19, 1032.
8. Sutherland, G. B. B. M., *Proc. Indian Acad. Sc. A*, 1938, 8, 341.

# ELASTIC CONSTANTS OF AMMONIUM ALUM

THE elastic constants of ammonium alum have been determined by the wedge method developed in this laboratory, using ultrasonic frequencies up to about 8 Mc/sec. This alum belongs to the cubic system, and sections parallel to the (100), (110) and (111) faces have been cut and ground to uniform thickness of about 1 mm.

In units of  $10^{11}$  dynes per cm.<sup>2</sup>, the measured elastic constants and the calculated bulk modulus (K) for this alum, along with those of potassium and chromium alums determined earlier by the author,<sup>1</sup> are given below.

No.	Substance	C <sub>11</sub>	C <sub>12</sub>	C <sub>44</sub>	K
1	Ammonium alum	2.50	1.06	0.80	1.54
2	Potassium alum	2.50	1.07	0.86	1.57
3	Chromium alum	2.37	0.93	0.77	1.41

For ammonium alum, the only experimental value available in the literature is that of Bridgman<sup>2</sup> for the bulk modulus. In our units, this is 1.542 which is practically identical with the value obtained in the present investigation.

Department of Physics,  
Andhra University,  
Waltair,  
January 26, 1948.

1. R. V. G. Sundara Rao, *Curr. Sci.*, 1947, 16, 91.
2. P. W. Bridgman, *Proc. Amer. Acad.*, 1929, 64, 51.



A NOTE ON THE CHEMICAL  
EXAMINATION OF NIM BLOSSOMS  
(*MELIA AZADIRACHTA*)

RESULTS of chemical examination of nim blossoms have been recorded by us in a previous publication.<sup>1</sup> Without making any reference to this work, Subramanian and Rangaswamy in a subsequent communication<sup>2</sup> claimed the separation of certain substances from the blossoms, which are not well defined and some of which appear to form only intermediate stages in the isolation of the various products reported by us. Thus the golden yellow oil reported by them was obviously a crude form of the sesquiterpene derivative. In this communication the isolation of two bitter principles (yield of one, 1.3 per cent.) from the blossoms has been reported. As the blossoms in the Delhi area are not bitter in taste, and no bitter principle was found to be present in any of the fractions derived from the alcoholic extract, it was considered advisable to check up the earlier results by following up the method adopted by Subramanian and Rangaswamy<sup>2</sup> in the working of the blossoms. No bitter principle could, however, be isolated from the blossoms in this area. On the other hand all the products isolated before<sup>1</sup> were identified in this working also.

The alcoholic extract from 2 kilos of the blossoms was repeatedly extracted with ether. From the ether-insoluble fraction, nimbicetin was obtained after acid hydrolysis.<sup>1</sup> The ether solution was then repeatedly extracted with 5 per cent. caustic soda solution. The residue (Ca. 35 gms.) after complete removal of the solvent from the well-washed and dried ether layer, was a thick, brownish, oily liquid with the characteristic pungent smell of the essential oil. It was digested with petroleum ether when a very small quantity of waxy white material was left behind. The petrol ether solution was repeatedly partitioned with 70 per cent. dilute alcohol, when a comparatively small quantity went into the alcoholic layer. The semi-solid, light brown gummy residue (Ca. 1.5 gm.) from the alcoholic layer had the characteristic smell of the essential oil and was not bitter to taste. The acrid pungent taste of the essential oil could, however, be detected with its alcoholic aqueous emulsion. On further digestion with hot petroleum ether, the residue yielded some more steam volatile product from the petrol ether digestive. The residue from petrol ether digestion formed a brownish yellow solid (Ca. 0.06 per cent.) with the smell of essential oil. This residue which would correspond to the bitter, marked "C" by Subramanian and Rangaswamy, was actually not bitter to taste. It was, moreover, optically inactive in contrast to the nimbidine series of bitters isolated from the various parts of the plant.<sup>4</sup> This residue was then subjected to steam distillation when a minute quantity distilled over. The resinous residue was a brittle, light brown solid, sparingly soluble in cold alcohol. It was hydrolysed with 5 per cent. cold alcoholic potash for 20 hours and worked up in the usual manner. Neither the neutral nor

the acidic component of the hydrolysates was bitter to taste.

The residue from the petrol ether—a brownish pasty mass with the pungent taste of the essential oil—when distilled with steam, yielded the major fraction of the essential oil (0.3 per cent.). The waxy, solid residue from the distillation had no marked taste, and on saponification with 20 per cent. alcoholic potash gave nimboesterol and nonakosane from the unsaponifiable fraction. The acidic components were not investigated further as the constituent acids had been exhaustively studied.<sup>1</sup>

The alkaline extract from the ether-soluble portion of the original alcoholic extractive was acidified with dilute HCl, and the greyish-brown precipitate filtered off. The aqueous filtrate was distilled, when it yielded the product corresponding to the acidic fraction of the essential oil.<sup>1</sup> The acidic precipitate on repeated purification with solvents, yielded a small quantity of a mixture of fatty acids which were not followed up further in this working.

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1. Mitra, Rao, Bhattacharya and Siddiqui, *J. Sc. Ind. Res., India*, 1947, **6** 8, 19. 2. Subramanian and Rangaswamy, *Curr. Sci.*, 1947 **16**, 182. 3. Siddiqui and Mitra, *J. Sc. Ind. Res. India*, 1945, **4**, 5. 4. Mitra, Rao and Siddiqui, *Proc. Indian. Sc. Cong.*, 1947 (Adv. Abs. Chem.) **73** a Mitra and Siddiqui, *Ibid*, 1948.

EFFECT OF SUPPLEMENTATION  
WITH TAMARIND AND CHILLI ON  
THE GROWTH OF YOUNG RATS ON  
A POOR-SOUTH-INDIAN-RICE DIET

ALTHOUGH millions of people have lived for generations, on a poor rice diet composed mainly of rice, the growth response and fertility of rats on experimental diets composed of the same major components have been repeatedly observed to be disappointing.<sup>1-4</sup> This apparent discrepancy is either due to the unsuitability of the rice diet to rats or, possibly, the absence of some supplement which forms a part of the normal human diet, but which is excluded from the experimental diet. A significant omission made in the formulation of the experimental rice diet is with regard to tamarind and chilli, which are invariably added to the rice diet as consumed in South India. As these two ingredients are normally considered to be unimportant in evaluating the food value of experimental diets, it is of interest to determine whether their incorporation would make any difference in the response of the rat to the Poor-South-Indian-Rice-Diet.

Twelve rats from our stock colony were weaned, eighteen days after birth, at the weight of 28 gms., and placed on the rice diet plus 10 c.c. of 10 per cent. Klim milk each till they

weighed about 40 gms. This preliminary procedure has been found to be desirable to accustom the rats to the rice diet. The rats were divided into two groups of six each with equal number of littermates of the same sex. The first group received a poor rice diet of the following percentage composition:

Polished rice, 78.5; tur dal (*Cajanus indicus*) 5.0; common salt, 0.3; non-leafy vegetables, 8.2; leafy vegetables, 2.1; whole milk powder (Klim), 0.9; crude groundnut oil, 5.0.

This diet does not differ materially from the conventional rice diet used by most of the earlier workers. The rice, dal, vegetables and salt were mixed together and cooked with three to four times its volume of water. The crude groundnut oil was mixed with the cooked diet. The milk powder was made into a 10 per cent. solution and fed to the rats separately.

For the second group, the diet was prepared in the typical South Indian style by using tamarind, chilli and extra salt to taste which together made up 2 per cent. of the diet replacing an equal proportion of rice in the above composition. An aqueous extract of the ripe tamarind as prepared in the household and dry chilli powder was used. Extra salt (0.2 per cent.) was also added so as to correspond to the normal diet.

The difference between the two diets in regard to essential constituents (protein, fat, carbohydrate, calcium and phosphorus) is almost negligible.

The growth rate of the animals over a period of 15 weeks are presented in Table I. It was observed that the animals in the second group took slightly longer to get adapted to the tamarind and chilli. The animals receiving tamarind and chilli as supplement were distinctly more active than those on the rice diet alone. In both the groups, there was shedding of hair but this was less pronounced in the tamarind group than in the control. There was no mortality in either of the groups during the experimental period. After that period, the animals were mated. Some of the animals of the tamarind group gave birth to litters, whereas none of the control group has so far done so in spite of over two months of pairing. The related observations will be continued with the succeeding generations.

TABLE I  
Poor Rice Diet

Sex	Initial wt. (average)	Final wt. (after 15 weeks) (average)	Average food intake (gm. dry wt.) per day	Average weekly increase gm.
M	40.5	105.3	8.2	4.34
F	40.2	94.7	8.07	3.61
Poor rice diet supplemented with tamarind and chilli				
M	40.8	123.0	8.57	5.5
F	39.3	110.0	8.33	4.7

The average food intake of the rats receiving supplement of tamarind and chilli was only slightly more than that of the animals on the rice diet. The increase in growth of the former was distinctly out of proportion with the extra food intake.

The above is only a preliminary note indicating the importance of two food components which had not been considered to be of any nutritional significance. Further work extending the above findings and designed to throw light on the mechanism of action is in progress.

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1. Aykroyd *et al.*, *Indian J. Med. Res.*, 1937, 24, 1093. 2. *Idem*, *Ibid.*, Memoirs No. 132. 3. Eleanor Mason *et al.*, *Ibid.*, 1943, 33, 219. 4. "Report to the Vana-pati Research Committee," Ministry of Food (unpublished).

#### FACTORS AFFECTING THE NUTRITIVE VALUE OF SOYA BEAN PROTEIN

It is now well known that the nutritive value of soya bean protein which is low in the raw state is appreciably raised by suitable heat treatment.<sup>1-5</sup> Johnson *et al.*<sup>6</sup> attribute this difference in nutritive value to the presence of a nitrogen-sulphur complex in the raw protein which, they believe, cannot be utilised and that heat treatment makes it available for tissue-building purposes. This has also been confirmed by later work.

Recently Ham *et al.*<sup>7-8</sup> found that a trypsin inhibitor in the raw bean interferes with the utilisation of protein. Melnick *et al.*<sup>9</sup> have also suggested the mechanism for the action of this inhibitor. Experiments carried out in this laboratory have led to the following interesting findings with regard to the role of the trypsin inhibitor and other possible factors affecting the nutritive value of soya bean protein.

- (1) The removal of the tryptic inhibitor by acid extraction of raw soya bean meal raises the growth-promoting value of the protein from 1.2 to 1.4, while autoclaving raises the value to 1.9.
- (2) The tryptic inhibitor being heat-labile, all types of heat treatment must be expected to increase the nutritive value of the protein to about the same extent; but only wet heating and particularly autoclaving has been found to have a beneficial effect on the nutritive value.
- (3) Germination of the soya bean increases the nutritive value of the protein; but the concentration of the tryptic inhibitors in the raw and the germinated beans remains the same.

The above evidence, as also the observations made by Riesen *et al.*<sup>10</sup> on the digestibility of



heat-treated soya bean meal would lead to the conclusion that, apart from the tryptic inhibitor, there are other factors which modify the nutritive value of soya bean protein.

There was the possibility of the existence in raw soya beans of toxic substances acting as anti-growth factors and which are destroyed by heat. The experiments of Osborne *et al.*<sup>11</sup> and Hayward<sup>5</sup> showed that raw soya bean did not contain any toxic factor soluble in fat solvents. Experiments were carried out in this laboratory to see whether the saponins or other water-soluble factors present in soya bean acted as toxic factors, but it was found that extraction with 70 per cent. alcohol or dialysis of the soya bean meal did not raise the growth-promoting value of the protein. These results lead to the conclusion that it is rather unlikely that soya bean would contain any toxic or growth-retarding factors.

The probable explanation that can be provisionally offered for the increase in nutritive value of soya bean protein by heat treatment is, therefore, in terms of a structural alteration of the protein. The experiments of Julian *et al.*<sup>12</sup> have led them to a similar conclusion.

The author's thanks are due to Prof. V. Subrahmanyam and Dr. S. S. De for their kind interest in the work.

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1. Osborne, T. R., & Mendel, L. B., *Jour. Biol. Chem.*, 1917, **32**, 369.
2. Vestal, C. M., and Shrewsbury, C. K., *Ind. Ed. Proc. Am. Soc. Animal Produ.*, 1931, **3**.
3. Shrewsbury, C. L., Vestal, C. M., & Hauge, S. M., *Jour. Agr. Res.*, 1932, **44**, 267.
4. Robinson, W. L., *Ohio Agr. Exp. Sta. Bull.*, 1930, 452.
5. Hayward, J. W., Steenbock, H., and Bohstedt, G., *Jour. Nut.*, 1936, **11**, 219.
6. Johnson, V., Steenbock, H., & Parsons, H. T., *Wis. Agr. Expt. Sta. Bull.*, 1937, 428.
7. Ham, W. E., and Sanstedt, R. M., *Jour. Biol. Chem.*, 1914, **154**, 505.
8. Ham, W. E., Sandstedt, R. M., and Mussehl, *Ibid.*, 1945, **161**, 327.
9. Melnick, D., Oser, P. L., and Weiss, *Science*, 1946, **103**, 327.
10. Riesen, W. H., Clandinin, D. R., Flvehjem, C. A., and Cravens, W. W., *Jour. Biol. Chem.*, 1947, **157**, 143.
11. Osborne, T. R., and Mendel, L. B., *Proc. Soc. Exp. Biol. and Med.*, 1917, **14**, 174.
12. Julian, P. L., *The Baker's Digest*, 1943, **17**, 19.

### STUDIES IN ANTIMALARIALS SOME N<sup>1</sup>-(8-QUINOLYL)-N<sup>5</sup>-PHENYL- BIGUANIDES

ANTIMALARIALS of the amino-quinoline series<sup>1,2,3</sup> have been attaining great importance in view of their value in treating the various types of malaria. Plasmochin,<sup>4</sup> Pentaquin,<sup>2</sup> Aralen<sup>5</sup>, all derivatives of amino-quinoline, exert definite curative and prophylactic action against malaria. Plasmochin, however, suffers from the disadvantage of being excessively toxic.<sup>6</sup>

In an effort to find out a better antimalarial, innumerable derivatives of amino-quinoline are, now-a-days, being prepared and their activity against malaria studied. The quest for an ideal antimalarial by Curd and Rose and their collaborators<sup>7</sup> resulted in the discovery of 'Palu-

drine',<sup>8</sup> a biguanide derivative, which is the least toxic and most potent of all existing antimalarials. With a view to combining the beneficial qualities of both these types of compounds, several derivatives of the quinolyl-biguanide, type (I), have now been synthesised.

The compounds were obtained by condensing 8-amino-quinoline hydrochloride with the appropriate aryl-cyano-guanidine in alcoholic or dioxane medium by refluxing for 8-12 hours. After treatment of the reaction mixture with dilute alkali solution the base was separated and purified. The hydrochloride or the acetate, as the case may be, of the base was prepared and characterised. While the hydrochlorides contain either two or three molecules of hydrochloric acid and one or two molecules of water of crystallisation, the acetates contain only one molecule of acetic acid and no water of crystallisation.

The compounds and their physical properties are given in Table I.

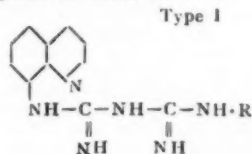


TABLE I  
N<sup>1</sup>-(8-Quinolyl)-N<sup>5</sup>-R-biguanides

δ Z	R	M.P. of base °C.	Salt	M.P. of salt °C.
1	Phenyl-	190(d)	3HCl, H <sub>2</sub> O	183(d)
2	p-Tolyl-	100-91(d)	2 HCl, H <sub>2</sub> O	196(d)
3	p-Anisyl-	179(d)	3HCl, H <sub>2</sub> O	168(d)
4	p-NO <sub>2</sub> -phenyl-	188-89(d)	2HCl, 2 H <sub>2</sub> O	238(d)
5	p-AcN I-phenyl-	250(d)	CH <sub>3</sub> COOH	277-38(d)
6	p-NH <sub>2</sub> -phenyl-		CH <sub>3</sub> COOH	151-52
7	p-Cl-phenyl-	191-92(d)	CH <sub>3</sub> COOH	204-205(d)
8	p-Br phenyl-	204-205(d)	CH <sub>3</sub> COOH	212-13(d)
9	p-I-phenyl-	239(d)	CH <sub>3</sub> COOH	213-14(d)

Full details will be published elsewhere.

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1. Magi'son, O. V., *et al.*, *J. Gen. Chem., U. S. S. R.*, 1938, **8**, 899.
2. Drake, N. L., *et al.*, *J. A. C. S.*, 1946, **68**, 1529.
3. No tan, T. R., *et al.*, *Ibid.*, 1946, **68**, 1572.
4. Schuleman, *et al.*, *Klin. Wchnscher*, 1932, **11**, 381.
5. Drake, N. L., *et al.*, *J. A. C. S.*, 1946, **68**, 1208.
6. Elderfield, R. C., *et al.*, *ibid.*, 1946, **68**, 1524.
7. Curd, F. H. S., *et al.*, *J. C. S.*, 1946, 343-84.
8. —, *ibid.*, 1946, 729.

# ASCORBIC ACID AND GLUTATHIONE CONTENT IN (HUMAN) BREAST CANCER TISSUE

A NUMBER of workers<sup>1-4</sup> have studied the mineral content of cancerous tissue. Investigations on the vitamin content, however, are still meagre. Picard and Marsden<sup>5</sup> showed that glutathione content was high in breast cancer but was not significantly so in recurrent cancer. The present note deals with the vitamin C and glutathione content in human breast cancer tissue.

Human breast tissues were obtained from patients suffering from cancer of the breast and undergoing a surgical treatment. The estimations were carried out within half an hour after excision of the tissue. The healthy tumour tissue was selected as far as possible free from necrotic areas and hemorrhage within the body of the tissue, while the normal portion was obtained from the adjoining part of the same breast. In doubtful cases the condition of the normal tissue was confirmed by histological examination. The tissue was carefully dissected and the adhering fat globules were removed. Each of the two tissues was gently pressed between filter-papers, and about one gram sample of each was accurately weighed and used for the determinations of ascorbic acid and glutathione by methods of Mindlin and Butler<sup>6</sup> and Woodward and Fry<sup>7</sup> respectively. The estimations were carried out in thirty samples of breast tissue, each of which afforded both a normal and a tumour portion for the investigation. The averages of the results are shown in the following table.

TABLE I

Mean Ascorbic Acid and Glutathione in Normal and Tumour Tissue of Human Breast (mgms. per cent.)

Breast Tissue	Ascorbic Acid	Glutathione
Normal	9.14 ± 1.10	24.09 ± 4.15
Cancer	14.90 ± 1.60	63.51 ± 7.06

The statistical treatment of the data by the application of "Students' t-test," showed the differences of ascorbic acid and glutathione contents in normal and tumour tissues as significant, and the chance of such a happening at random is less than 1 in 1,000.

These observations on human breast tissues demonstrate that the metabolic processes of cancerous tissue of human breast are probably different from those proceeding in the normal part of the same breast tissue, and the higher concentrations of ascorbic acid and glutathione in tumour tissues are probably concerned in the processes of malignant growth.

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1. Brunschwig, A., Dunham, L. J., & Nichols, *Cancer Res.*, 1946, **6**, 230.
2. Dunham, L. J., Nichols and Brunschwig, A., *Ibid.*, 1946, **6**, 233.
3. Stowell, R. E., and Cooper, Z. K., *Ibid.*, 1945, **5**, 295.
4. Buchwald K.W., and L. Hudson, *Ibid.*, 1944, **4**, 615.
5. Picard R. J., and Marsden, C. S., *J. Lab. Chem. Med.*, 1934, **19**, 395.
6. Mindlin, R. L., and Butler, A. M., *J. Biol. Chem.*, 1938, **122**, 672.
7. Woodward, G. E. and Fry, E. G., *Ibid.*, 1932, **97**, 465.

## INDIAN WILD CHERRY BARK

WILD Cherry bark is the bark of *Prunus serotina* Ehrhart (family Rosaceae), collected in autumn, when it is most abundant, and carefully dried and stored. The tree grows wild in North America, and most of the bark of commerce comes from Virginia, Indiana, North Carolina and Michigan.

The drug is popularly employed to relieve cough in Phthisis and bronchitis of various types. The mildly sedative properties of the drug is generally attributed to the small quantity of the hydrocyanic acid present.

*Prunus serotina* is not indigenous to India, but there are several species of *Prunus* which are either cultivated for their fruits or grow wild in India. An attempt was made to investigate if any of these species could form a good substitute for the official bark used for medicinal preparations.

The barks of *Prunus amygdalus* Baily (Ver-nacular Badam), *P. avium* Linn. (Ver. Gilas), *P. armeniaca* Linn. (Ver. Khubani), *P. communis* Huds. (Ver. Alubukhara), *P. persica* Benth. (Ver. Aru), *P. padus* Linn. (Ver. Bharat), *P. cerasus* Linn. (Ver. Jangali gilās) were analysed.

The last two species grow wild at 5,000 to 7,000 ft. above sea-level, while the other species are cultivated extensively in the Kashmir valley for their fruits. Various parts of the plants of the above-mentioned species are generally used in the indigenous system of medicine.

The bark was collected from the stem and branches in the autumn season, dried and analysed. The results are tabulated below.

TABLE II  
Analysis of Indian Wild Cherry Bark

Name of species	% of total ash	Acid in-soluble ash %	Alcohol ex-tractive with 60% alcohol (B.P. Method)	Hydro-cyanic acid, %
<i>Prunus amygdalus</i>	19.5	2.2	13.2	0.0022
<i>Prunus avium</i> ..	6.3	0.94	14.2	
<i>P. armeniaca</i> ..	7.9	0.96	18.4	
<i>P. communis</i> ..	7.4	1.9	19.2	0.0043
<i>P. padus</i> ..	10.6	0.96	21.1	
<i>P. persica</i> ..	6.1	2.4	28.8	0.015
<i>P. cerasus</i> ..	3.6	0.31	18.1	traces
<i>P. serotina</i> B.P.C.	3 to 4	0.2 to 0.6	17 to 23	0.075 to 0.16
standards				

The results show that with regard to the HCN content none of the barks of the locally growing species of *Prunus* comes up to the standards laid down for the official drug. Attempts are, however, being made to cultivate *Prunus serotina*, on an experimental basis, as the requisite climatic conditions are available.

We are grateful to Col. Sir Ram Nath Chopra for his valuable guidance in the course of this investigation.

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### AUTOTETRAPLOIDY AND ATTENUATING POWER IN YEASTS

INDUCTION of polyploidy has been claimed to be an important method for the improvement of crop plants. Duplication of the chromosome complement is followed in some cases by characteristic changes in the biochemical behaviour. Rowson<sup>1,2</sup> has shown that autotetraploids have a higher alkaloid content than the diploids. Randolph and Hand<sup>3,4</sup> give quantitative data on the carotenoid content and vitamin A activity of diploid and autotetraploid corns.

Little work on similar lines has, however, been reported in the case of yeast and fungi for the simple reason that the chromosome constitution of most of the strains are unknown. Conflicting reports have been published recently on induction of polyploidy in *P. notatum*<sup>5,6</sup> as well as its relation to penicillin production.

In this laboratory two strains of beer yeasts of known chromosomal constitution are available. The tetraploid strain, BY 3, was obtained by treating the original diploid, BY 1, with acenaphthene.<sup>7,8</sup> This tetraploid has been constantly under observation for the past two years. The vitaminic requirements of the diploid and tetraploid strains were shown to be similar,<sup>9</sup> but their rates of growth are different.<sup>10</sup> It was thought, therefore, that a comparative study of the attenuating power of the two strains would be interesting. An extensive series of experiments with varying sugar concentrations (16 per cent. to 40 per cent.) and yeast inocula have been carried out. A representative set of results is presented below.

The inocula for the fermentation trials were built up by growing the strains in wort with vigorous aeration. In each case a 24 hour culture in wort was centrifuged, washed and resuspended in saline under sterile conditions to be used as the "pitch". Equal amounts of the two strains on the moist weight basis were then inoculated in sugar solutions contained in 100 ml. flasks. 25 ml. of the fermenting mixture after inoculation contained sucrose 6 gms.,  $\text{KH}_2\text{PO}_4$  0.4 gm.,  $(\text{NH}_4)_2\text{SO}_4$  0.4 gm., and yeast 1.2 gm. (moist weight).

In each case the rate of attenuation was determined by noting the specific gravity of the fermenting mixture at intervals by means of a Westphal specific gravity balance. Alcohol percentages were calculated from the attenua-

tion data and the results have been graphically represented in Fig. 1.

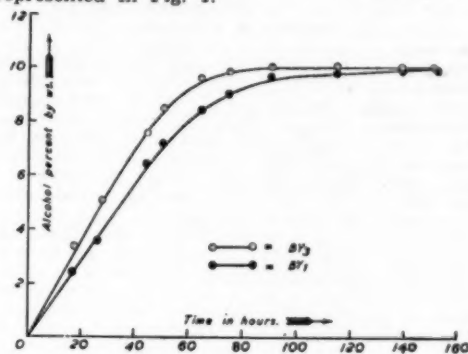


Fig. 1  
FIG. 1

It will be seen from the figure that the rate of attenuation is much faster in the case of the tetraploid strain. A careful study of the graph reveals that at any stage of fermentation the rate of alcohol production is approximately 30 per cent. faster than that by the diploid. The quickening in the rate of attenuation does not, however, reflect itself in the final yields of alcohol. The final concentration of alcohol in the media is the same in both cases although the limit is reached much earlier in the case of the tetraploid.

It appears that duplication of the chromosome complement in yeasts leads to an increase in vigour in that not only is there an acceleration of the rate of growth but also a quickening of the rate of attenuation.

I am very grateful to Sir J. C. Ghosh, M.A., D.Sc., F.N.I., for his active interest and encouragement, to Dr. M. K. Subramaniam for the cultures and a discussion of the results, and to the Council of Scientific and Industrial Research for generous financial assistance.

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1. Rowson, J. M., *Quart. Pharm. Pharmacol.*, 1945, **18**, 175-84.
2. —, *Nature*, 1944, **154**, 81-82.
3. Randolph, L. F., and Hand, J. *Agr. Res.*, 1941, **60**, 57-64.
4. —, *Science*, 1938, **87**, 442-3.
5. Sansone, E. R., and L. Banner, *Lancet*, 1946, **250**, 828-9.
6. Gordon, W. W., and J. A. Mac, *Ibid.*, 1945, **248**, 47.
7. Subramaniam, M. K., *Proc. Nat. Inst. Sci. (India)*, 1946, **12**, 143.
8. —, *Ibid.*, 1947, **13**, 131.
9. Prema Bai, M., *Curr. Sci.*, 1947, **16**, 317.
10. Prema Bai, M., and M. K. Subramaniam, *Ibid.*, 1947, **16**, 380.

### 'RAYUNGAN' METHOD FOR SPEEDY MULTIPLICATION OF SEED MATERIAL IN SUGARCANE

EXPERIMENTAL stations are often faced with the difficulty of shortage of seed material of the new varieties which they receive from outside

or those that evolve themselves out of their selections. It often takes three to four years before one could get enough seed material for including the seedling in a properly randomised field-scale experiment. To expedite the multiplication of the seed material, 'Rayungan' method as described by Dillewijn<sup>1</sup> has been tried with slight modifications at Shahjahanpur. The method offers a much better scope for raising larger quantities of seed material than is possible by the ordinary method of multiplication, and consists of germinating the buds on the standing cane prior to planting in the field. To induce shooting in the buds the cane is topped, four to six weeks before the time of planting, with a sharp field knife of *hansia* (scythe). The topping cut is made in a slant in one stroke at a point as far as the millable cane is formed. The cane is then stripped off the leaves. The crop after topping is given a light dressing of ammonium sulphate, say, at the rate of 20 lb. nitrogen per acre and irrigated once or twice only. As soon as the buds grow into sufficiently developed shoots, called 'rayungans', 4 to 6 inches long, the cane is cut into one-budded setts which are planted in trenches previously prepared and manured. In handling the 'rayungans' much care is necessary to avoid damage, mainly due to their breaking at the base near the attachment with the sett. The leaves of the 'rayungans' are partly clipped off before planting in the soil to reduce transpiration. An irrigation is given immediately after planting. Frequent but light irrigations are subsequently given till the seedlings take root, and later, as with the normal plantings.

This method ensures germination and gives a greater amount of success as compared with the normal method of planting setts in the soil, in which, in spite of a rigorous selection of buds and provision of optimum conditions for planting, the germination (under Shahjahanpur conditions) seldom exceeds 30 to 50 per cent.<sup>2</sup>

The results of a field trial comparing the two methods are given below. The cane in this case was topped in the first week of April and planted in the first week of May 1947. The variety used was CoS. 186.

TABLE I

Method	No. of buds Planted	No. of shoots established	No. of millable canes on 30-9-47
New	80	69	221
Normal (Old)	80	33	115

The difference between the two methods as given above is very significant inasmuch as the germination and the subsequent amount of seed material (as judged by the number of millable canes) available are almost twice that secured with the normal method of planting.

It was also observed that the canes with the new method of planting were taller, thicker and healthier in look, due to the earlier establishment of shoots than is secured from the nor-

mally planted canes. This method has also the possibility of being adopted for late plantings in which normally a good stand is seldom achieved.

Further experimentation in this connection is in progress.

B. K. MUKERJI,  
RAM KRISHAN.

Main Sugarcane Research Station,  
Shahjahanpur (U.P.),  
January 19, 1948.

1. Dillewijn, Ir. C. Van, *Bulletin of the Sugarcane Expert. Istanbul* (1947). 2. Singh, S. B., and Krishan, R., *Proc. Sugar Tech. Association, India* (1946).

### OCCURRENCE OF *MYROTHECIUM RORIDUM* TODE EX FRIES ON COW-PEA IN INDIA

In September 1945 and 1946, a leaf-spot disease was noticed on cowpea, *Vigna unguiculata* (Linn.) Walp. in Krishnanagar, Bengal. The fungus associated with the disease was identified as *Myrothecium roridum* Tode ex Fries. The genus *Myrothecium* has not been recorded in India.

**Symptoms**—The leaf-spots begin as minute, brownish dots, 1-2 mm. in diameter, having a raised margin, slightly pinkish violet in colour and a depressed centre, which is brown, thin and translucent. When the fungus invades the surrounding tissue a second zone is formed around the original spot. In the second zone also the thin and translucent brownish area is surrounded by the raised margin of a pinkish colour. Sometimes two or three such thin central areas have a common coalescing outer zone. The diameter of the inner and outer areas vary widely from a few millimetres to 2.5 cm. or more.

**Morphology of the fungus**—The sporodochia are produced on the dorsal surface of the laminae in the thinner zones of the spots. At first small islands of white, woolly, pseudoparenchymatous stromata, about 1 mm. in diameter arise. These stromata are composed of the intertwining conidiophores. The spores are produced from a closely packed hymenium-like layer of phialides. The spores remain aggregated together forming a jet black, viscid mass. Several of these sporodochia are produced in a circle in the spots and the spore masses merge with one another forming a more or less continuous irregular black circle.

The conidia are cylindrical or slightly tapering with rounded ends, continuous, 2 guttulate, hyaline at first, becoming pale green with a prominent black wall, measuring  $10\mu \times 3\mu$  on the average.

Preston<sup>1</sup> studied the genus, *Myrothecium* and its three classic species, *M. inundatum* Tode ex Fr., *M. roridum* Tode ex Fr., *M. verrucaria* (Alb. & Schwein) Ditmar ex Fr., and has published emended descriptions of the same.

The fungus has been reported from England on *Viola tricolor*, *Antirrhinum majus*, *Lycopersicon esculentum*; from Sierra Leone, West Africa, on *Hibiscus esculentes*, *Dolichos lablab*,



*Trichosanthes*, and *Asclepias* sp.<sup>1</sup>; and from California on *Gardenia*.<sup>2</sup> It will be observed that the above list includes well known Indian cultivated vegetables and garden plants, on none of which the fungus has so far been reported from this country.

The specimens have been deposited at the Imperial Mycological Institute, Kew, Surrey, England.

The author is indebted to Dr. E. W. Mason of the Imperial Mycological Institute, Kew, Surrey, for identifying the fungus.

Central Rice Research Institute,  
Cuttack, S. Y. PADMANABHAN.  
January 9, 1948.

1. Preston, N. C., *Trans. Brit. Mycol. Soc.*, 1943, 26, 158. 2. Barrel, J. T., and Doris Ann. Hardman, *Phytopath.*, 1947, 37, 360.

# ENATION MOSAIC OF *DOLICHOS LABLAB* LINN., A NEW VIRUS DISEASE

IN August 1939 a mosaic disease accompanied by chlorotic streaks was observed in *Dolichos lablab* grown on the Agricultural College Farm, Poona. The disease reoccurred on the farm for three consecutive seasons, but was observed only occasionally afterwards. It has not been found to occur in other localities of this province.

The first symptoms of mosaic appear in young leaves of *Dolichos lablab* about twenty days following inoculation under controlled conditions with sap expressed from diseased plants. Subsequent leaves show severe mosaic accompanied with chlorotic streaks (Fig. 1). The

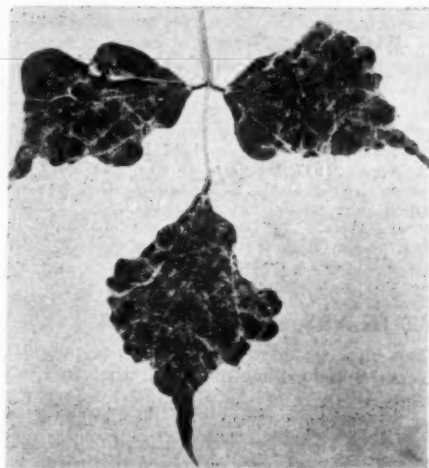


FIG. 1. Leaf of *Dolichos lablab* affected by enation mosaic virus.

leaves of affected plants are malformed and produce foliar enations on their undersides

(Fig. 2). There is also a marked reduction in size of leaf-lamina due to inhibition of growth of the interveinal areas.



FIG. 2. Leaflet of *Dolichos lablab* showing large foliar enations as a result of infection with enation mosaic virus.

**Transmission.**—The virus is readily transmitted by sap inoculation. But transmission tests done with *Empoasca devastans* Dist., *Empoasca* sp., *Aphis medicaginis* K., *Ayyaria chætophora* K., *Tæniothrips distalis* K., the insects which colonise on *Dolichos lablab*, and *Aphis gossypii* Glover collected from cotton plants unsuccessful.

The dilution end-point of the virus in crude sap lies between  $5 \times 10^{-6}$  and  $3 \times 10^{-6}$ . It can withstand heating for 10 minutes at  $90^{\circ}\text{C}$ ., but is inactivated at  $95^{\circ}\text{C}$ . The virus was still active after six years at laboratory temperature.

The virus has a wide host range. Besides *Dolichos lablab*, it infects a large number of

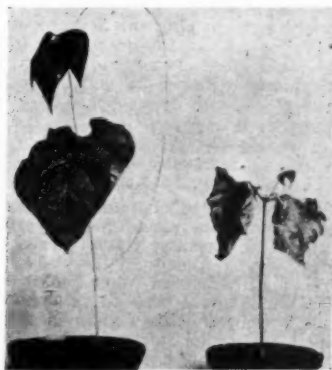


FIG. 3. Healthy and diseased plants of *Phaseolus vulgaris*. The affected plant shows systemic necrosis,



leguminous plants. In *Phaseolus vulgaris* it induces systemic necrosis which kills the whole plant (Fig. 3). In *Nicotiana tabacum*, variety White Burley, it produces primary lesions which appear as thin, white rings of necrotic tissue enclosing green areas, and the disease, on becoming systemic, appears as mosaic mottling after about 65 days following inoculation. The virus does not infect *Cucumis sativus*, *Datura alba* and a large number of other plants.

Although the physical properties of *Dolichos* virus closely resemble those of the tobacco mosaic virus,<sup>1</sup> it markedly differs from the latter in respect of its host range and in the type of symptoms produced in tobacco itself. In addition, the cross immunity tests carried out with the two viruses in *Nicotiana tabacum*, variety White Burley, indicated that neither of the two viruses protects tobacco plants from infection with the other. The *Dolichos* virus is, therefore, not related to the tobacco mosaic virus.

The *Dolichos* virus has no relationship with any of the legume viruses,<sup>1</sup> except that its thermal inactivation point approximates to those of the Bean viruses 4 and 4A<sup>2</sup>, and its dilution end-point is as low as that of the Pea Streak virus.<sup>3</sup> It is proposed that this new virus may be known as '*Dolichos enation mosaic*' virus.

Sincere thanks are due to Dr. B. N. Uppal under whose guidance this work has been done. This investigation is being carried out under a scheme financed by the Indian Council of Agricultural Research.

College of Agriculture,  
Poona,  
January 15, 1948

S. P. CAPOOR.  
P. M. VARMA.

1. Smith, K. M., "A Text-Book of Plant Virus Diseases", London, 1937. 2. Zaumeyer, W. J., and Harter, L. L., *J. Agric. Res.* 1943, **67**, 305. 3. Chamberlain, E. E., *New Zealand J. Sci. and Tech.*, 1939, **20**, 381A (in *Rev. Appl. Mycol.*, 1939, **18**, 648).

#### PENAEID PRAWNS BREEDING IN FRESH WATER

In a recent note in *Current Science* on the migratory fishes of the inland waters of Madras, Chacko<sup>1</sup> states that berried individuals of four prawns, namely, *Palæmon malcolmsoni* Milne-

Edwards, *Palæmon scabriculus* Heller, *Penæus indicus* Milne-Edwards and *Metapenæus monoceros* Fabr. were found in the Godavari river both above and below the anicut. On the basis of this it is presumed by this author that these prawns breed in the river.

As Penæid prawns are well known to hatch out as naupalii, and the adult females of *Penæus* spp., and *Metapenæus monoceros* are not known to carry eggs attached to the abdominal pleopods<sup>2</sup> it is most unusual if berried individuals of *P. indicus* Milne-Edwards and *M. monoceros* Fabr., have been observed. All available evidence is that in the Penæid prawns the eggs are shed in the surrounding water.<sup>3</sup> What seems probable is that there has been some confusion in regard to the species dealt with by Chacko, and it appears to me that the berried prawns seen near the Godavari anicut could not have been Penæids but only Caridian prawns, probably Palæmonids. The statement that *P. indicus* breeds in inland waters at a distance of 100 miles from the sea has also to be re-examined and, if confirmed, it is in substantial disagreement with our knowledge of this species. But as this is based on the occurrence of so-called berried specimens of *Penæus* spp., it need not be taken seriously.

It may be added that recent experiments which I have carried out indicate that the Penæid, most tolerant to fresh water, is *M. monoceros*. This species probably breeds in coastal zones not directly connected with the sea as found from Dakin's results in Australia and the observations made at Madras.<sup>4</sup> Of the other two Penæids of commercial importance on Coromandel coast, viz., *P. carinatus* and *P. indicus*, the one less tolerant to low salinity is *P. indicus*. The field data at Madras, the Collair Lake and at the Chilka Lake are also in agreement with this experimental result.

Central Marine Fisheries  
Research Station,  
Triplicane, Madras,  
January 29, 1948.

N. KESAVA PANIKKAR.

1. Chacko, P. I., *Curr. Sci.*, 1947, **16**, 290. 2. Dakin, W. J., *Nature*, 1947, **158**, 99. (Most of the early references are cited by Dakin.) 3. Gurney, R., "Larvae of Decapod Crustacea," *Ray. Soc.*, 1942. 4. Panikkar, N. K. and Aiyar, R. G. *Proc. Indian Acad. Sci.*, B, 1939, **9**, 343.

#### PHOTOSENSITIVE GLASS

Glass exposed for years to light and heat has been observed to change its colour. Based on this observation, researches have been carried out at the Corning Glass Works of U.S.A. Reactions taking place in crystal-clear ruby glass on application of ultra-violet light and heat treatment gives rise to several shades of colour. A photosensitive glass has now been developed in which pictures may be printed with a three-dimensional effect, caused by depth of image penetration, and with a variety of colours and extremely fine detail.

The light-sensitive ingredients are mixed into the batch before melting and, therefore, form an integral part of the glass. Prints are made, first by exposure to ultra-violet light and then, in an oven, to a temperature of 1,000°-1,100° F. After baking for half an hour a picture is formed with coloured particles so fine that they cannot be seen under a microscope. Photographic designs in blue, purple, ruby or orange is said to be possible with transparent glasses,

## REVIEWS

### New Developments in Ferromagnetic Materials.

By J. L. Snoek. (Elsevier, Distributors: Cleaver Hume Press, Ltd., 42-A, South Audley Street, W. 1, London), 1947. Pp. 136 + viii. Price 13sh. 6d.

The book is one of a series of monographs on the Progress of Research in Holland. The purpose of these publications is, according to the Foreword, "to show to the world that scientists in the Netherlands have remained active during the five years of German occupation". The monograph under review is a connected report on the various original investigations on Ferromagnetism carried out during those five years, and would be of great interest to those who are actively engaged in research in these fields. The results reported indicate the praiseworthy co-ordination that has existed between the theoretical and the practical research workers in Holland.

The book is made up of three chapters, the first two dealing with the statics and dynamics of ferromagnetism and the third with the development of new magnetic materials. The first part contains the various consequences of Kersten's extension of the theory of ferromagnetic hysteresis, which is based on the concept of crystal anisotropy and magnetostriction. One of the many results that follow from this theory is that a substance is expected to have a very high value of the initial permeability and a low value of the coercive force if its crystal anisotropy and magnetostriction are both zero. By a careful survey of such "zero points" in binary and ternary alloys, F.C. Went has discovered a new alloy of the permalloy type. The first chapter also contains some experimental discoveries which show that the present theories of ferromagnetism are quite inadequate. Of particular interest is the one in which it is found that crystals of magnetite develop a strong ferromagnetic anisotropy below  $114^{\circ}5$  K. although the ionic lattice does not undergo any change of symmetry.

The second chapter deals with researches on the magnetic skin effect, and on the various forms of "after-effects", such as magnetic, elastic and ionic, and the time decrease of permeability, very aptly called Dis-accommodation by the author.

The last chapter describes the preparation and the study of the properties of a series of new non-metallic ferromagnetic substances. These substances are produced by appropriately mixing different chemical compounds which go by the name of ferrites. These ferrites have a general formula  $MO, Fe_2O_3$  (where M is a bivalent element) and have the well-known spinel structure. The resulting mixture, commercially known as "Ferroxcube", is a mixed crystal having the same crystal structure. These new magnetic materials are easily workable by grinding and lapping and have a very high specific resistance while the "joints" show very low magnetic resistance. Four different types of materials have been described and their usefulness in most varied purposes involving high frequencies have been proved.

The book contains five appendices, three of which are reprints of papers published in different European Journals.

S. RAMASESHAN.

### Why Smash Atoms? By A. K. Solomon. (Penguin Books, Harmondsworth, Middlesex, England.) Pp. 160.

This is the popular edition of a book that was first published in America in 1940. In keeping with the object of popularising the latest advances in science, the fascinating story of the atom and its breaking has been presented here for the layman. The narration assumes very little on the part of the reader and thereby gains in lucidity.

Beginning with the historic experiments of Benjamin Franklin, the fundamentals are logically developed through the discovery and the definition of the electrons, the canal rays and the neutrons. The discovery of radioactivity and the experiments thereon of Rutherford leading to the elucidation of the common structure of atoms are then described. Further clarification and formulation of the atomic structure by Borh, and the discovery of isotopes by Moseley make fascinating reading.

The story of atom-smashing, beginning with natural radiations, by Rutherford, and then with accelerated particles are described with convincing detail. Numerous diagrams and photographs sprinkled throughout the book help immensely in the comprehension of the subject. But the most important section of the book, to the layman, is "why bother smash the atom?" The consequences of the preceding fundamental researches, in war and peace, are clearly brought out in the III Part. The discovery of induced radio-activity, and the production of radioactive elements on a mass-scale with their enormous usefulness in Medicine and Biology greatly impress the reader, and convinces him that scientists have not, after all, gone mad, and that basic researches are essential for application to human welfare.

In this age of democracy, the importance of the correct appreciation of the fundamental discoveries of science by the man in the street cannot be overestimated, for the "effective application of scientific improvements requires a thorough popular understanding of scientific discoveries". The publishers have eminently succeeded in popularising a scientific subject of first rate importance.

In India it would be a great step forward if such popular publications are retold in Indian languages for the benefit of the masses who have a great leeway to make up in their knowledge of progress of the rest of the world through the application of science before they can effectively co-operate with the government in national development.

In the next edition of the volume such statements like, "An alpha particle—a doubly charged helium atom" (p. 36), may be avoided without sacrifice of lucidity.

K. S. R.

**The Machinists' and Draftsmen's Handbook.**

By Albert M. Wagener, M.E., and Harlan R. Arthur, A.S. (Messrs. Macmillan & Co., Ltd., London), 1946. Pp. 662. Price 28sh. net.

Engineering handbooks are generally written either elaborately or in a condensed form with the result that the information required is too tedious to get at or difficult to understand without sufficient knowledge of fundamentals. *The Machinists' and Draftsmen's Handbook* is written with a view to eliminating this drawback. As stated in the preface of this book, "most men in the craft have studied mathematics but it is very quickly forgotten by the majority of them". So, this book starts with elementary mathematics and simple geometric constructions which are essential for making and setting out jobs.

The second part of the book deals with modern machine tools, speeds, feeds, limits and tolerances which are important for modern mass production and from the point of view of interchangeability of parts. Due importance is also given to the various milling operations and the chapter on milling is thorough and exhaustive.

The last part of the book is on strength of engineering materials thus giving the operator an idea of the right type of material to be used in the right place. There are a number of useful tables for ready reference, and the book is quite useful to the machinist in his day-to-day work.

But, from the point of view of a draftsman this book is a little disappointing. The draftsman can no doubt use the information given in it, but he needs a lot more for working in an engineering drawing office. For example, the principles of drafting or the various drafting conventions to be used on a working drawing are nowhere mentioned in the book. So the book would have justified the title if it had been "Machinists' Handbook". However, the book is quite useful not only to the machinists working in the shops, but also to the student in a trade school where the machinist trade is taught.

M. R. K. RAO.

**Statistical Year-Book of the League of Nations, Geneva, 1942-44. 17th issue. Edited by M. Grzegorz Frumkin of the Economic Financial and Transit Department, 1945. Pp. 315, and 108 tables.**

This is a valuable document giving all available information regarding population and vital statistics, movement of population, unemployment, production—agricultural, mineral and industrial—trade, prices, currency and banking statistics and public finance for 44 countries of the world for the years 1942-44 on the eve of the formation of the U.N.O. This publication was issued when the second World War was in progress; and so, numerous difficulties of communications and restrictions had to be faced and hence the delay in the issuing of the year-book. A number of belligerent or neutral countries had suspended publications of their statistics. For certain countries for which data were not available, estimated figures are given and are, therefore, liable to error. In

spite of all these obstacles, the department have enriched the fund of information contained by adding new tables regarding national income of eight countries (the U.S.A., the U.K., Australia, Canada, New Zealand, Union of South Africa, Argentine and Palestine). Two other new tables relate to marriage and marriage rates. The table concerning world trade in terms of Dollars has been omitted from this issue, and some other improvements have been carried out. This is a very useful addition to any statistical library.

M. C. SATYANARAYANA.

**The Artificial Insemination of Farm Animals.**

Edited by Enos J. Perry. (Chapman & Hall, Ltd., London), 1947. Pp. 265. 15sh.

The development and use of the technique of Artificial Insemination have in recent years eclipsed the progress of other phases of Animal Industry. The mass of scientific information that has accumulated has been brought out in an easily understandable form in this handbook. This helps the animal breeder tremendously in quickly and safely overcoming the time and cost factors in achieving increased production of the various commodities of animal origin. The need for this has probably been never so urgent as now, particularly in India.

This publication is a British edition of the original U.S.A. edition of 1945; but, instead of being brought up to date, it has all the previous printing errors. The editor having no easy job in co-ordinating a number of contributions, the handbook suffers from repetition and lack of uniformity in the presentation of the subject-matter. Inclusion of tabular statements for heat duration, sperm concentration in an ejaculate and the sperm number, and charge-volume required for successful insemination in different species, and a comprehensive discussion on the disorder in reproductive phenomena, on fertility variation and control, would have greatly helped the work of the inseminating centres.

Lucid citations of modern breeders' successes in breeding for improvement, will encourage the future cattle breeders, whetting as they do the appetite for more knowledge of the mystery and manifestations of biotic inheritance.

Chapters 10, 11 and 12 are, however, out of place and not without errors (coefficient of inbreeding, etc.). Probably in an overzealous attempt to simplify, expressions have crept in, which rather detract from the scientific accuracy of the new and quickly-grown knowledge of Genetics. Characters may be hereditary or environmental or due to a combined effect of both these factors. They may be said to be of three kinds but not due to three factors, as mentioned on page 151. Gene legends in the body of the text should be italicised. Further, it may be clarified that the F<sub>1</sub> in a tri-hybrid cross covers a total of 64 individuals making the full ratio, which comprises only 27 different genotypes grouped under 8 different phenotypes, but does not have 64 genotypes as is stated on page 158. The difference between sex-influenced and sex-limited characters is hardly clear. With these topics the operators of the artificial-insemination centres need not have been bothered.

The rest of the handbook will, however, be immensely helpful to the operators of the artificial insemination centres. Prof. Enos J. Perry has been a notable pioneer in the U.S.A. for the popularisation of artificial insemination, and his comprehensive discussion of the Organization Aspects is very useful. The misconceptions regarding artificial insemination are pointed out, and helpful suggestions given all through the book for making Artificial Insemination service to be widely adopted. But in India, the operator must understandingly tackle the agrarian and the village folk who are the virtual custodians of our cattle industry.

S. V. CHANDIRAMANI.

**The Age of the Saline Series in the Salt Range, Punjab.** *Proc. National Academy of Sciences, India, Sec. B, Vol. 16, 1946.*

The Age of the Saline Series of the Punjab has been the subject of a long-standing controversy. A Symposium on this subject was held in Poona during 1944 and the opinions expressed by the Palaeontologists led by Prof. Birbal Sahni, based on a study of the fossils, were all in favour of a Tertiary Age, but there were sharply divided views amongst the Geologists who based their conclusions on the field evidences. The consensus of opinion then was that further detailed investigations should be made to scrutinise the field data and substantiate the fossil evidences. Accordingly, excursions were arranged to selected exposures of the rocks, and extended studies of fossil material were also made. These developments led to a second Symposium during December 1945, at Udiapur, under the joint auspices of the National Academy of Sciences and the Indian Academy of Sciences. Twenty papers have been contributed to this Symposium by different authorities both from India and abroad, and the discussions cover almost every phase of this vexed question—setting forth not only the results of the most careful and intensive micro-fossil studies but also of the field excursions.

On going through the above Proceedings, it is clear that the fossil evidence in favour of the Tertiary Age is now more convincing than ever and that the reading of the field evidence requires a revision on the part of those who uphold a Cambrian or Pre-Cambrian Age. As Prof. Sahni has warned, "Between the testimony of the rocks and the testimony of the fossils there can be no real conflict," it looks reasonable that the verdict of the fossils should be accepted and the tectonic interpretations re-oriented in the light of these facts.

M. B. R.

**Mathematics as a Culture Clue and Other Essays.** Vol. I of the collected works of C. J. Keyser. (*Scripta Mathematica*.) Pp. 277. \$3.75.

The proposition that "the type of Mathematics found in any major culture is a key to

the distinctive character of the culture taken as a whole" was first put forth by Oswald Spengler in his *Der Untergang des Abendlandes*. Keyser meditates on this proposition and is inclined to support it. He devotes the major portion of his essay to the examination of classical Western culture, and infers that there is a family-likeness between classical mathematics, classical painting, classical philosophy, etc., which are all characterised by the absence of the concept of the infinite and are confirmed to the finite. But as the author himself points out, the proposition is yet to be supported by the general consensus of expert opinion. In fact it is a debatable proposition. For, as a freak of nature, a mathematical genius, far above the level of the ordinary folk, may appear in any country at any time. It is, therefore, quite possible that the advancement of mathematical work in a given country at a time is not representative of the culture. For instance, the Indian genius, S. Ramanujan, was not intelligible to his contemporaries in his own country and had to go abroad!

Besides the essay on Culture Clue, the collection contains eleven other essays on interesting topics such as "The Meaning of Mathematics", "The Bearings of Mathematics", "Mathematics and the Dance of Life", "Scientists Teach Laymen", etc. The reader may feel that some of the statements in the book are audacious or exciting, but the thinking is always clear and the presentation simple and straight. The printing and get-up are quite good.

B. S. SASTRY.

### Publications Received

"Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1944-45." (Published by the Government of India Press, Calcutta, 1948.)

"Portraits of Eminent Mathematicians". (Published by Chronica Botanica Co., N.Y. Portfolio I. II Edn.)

"John Couch Adams and the Discovery of Neptune". By W. M. Stewart. Occasional Notes No. 11, August 1947. (Royal Astronomical Society, London.)

"A Note on the Occurrence of Mica in Hyderabad State". By Khurshid Mirza, Director of Mines, and Geological Survey, Hyderabad (Deccan), 1943. Price As. 8.

"Bamboo for Pulp and Paper Manufacture"—Parts I-III. By M. P. Bhargava, Forest Research Institute, Dehra Dun, 1946. Price As. 9.



## SCIENCE NOTES AND NEWS

## Inter-University Board

The Inter-University Board met in Cuttack during the first week of December under the presidency of Mr. N. K. Sidhanta.

The Board passed a resolution on a proposition sent by the Bombay University expressing the opinion that it is in general agreement that the autonomy of Universities be maintained and that their academic independence be ensured. This principle is urged to be borne in mind when any new legislation affecting universities is contemplated.

The question of the national language of India came up before the Board on two propositions, one from the Standing Committee which passed a resolution in March last, but was deferred.

On the proposal of the Nagpur University for the adoption of Hindi as the medium of official minutes and correspondence, the Board considered that the suggestion was not practicable.

## University Grants Committee

In view of the recent constitutional changes and the additional responsibility that the Central University Grants Committee will have to undertake in the co-ordinated development of University education in the country, the Government of India have reconstituted the University Grants Committee with an enlarged membership. The Rt.-Hon'ble Dr. M. R. Jayakar is the Chairman, and the members are Mrs. Hansa Mehta, Sir S. S. Bhatnagar, Dr. M. N. Saha, Sir Homi Modi, the Hon'ble Dr. P. Subbarayan, Dr. Zakir Husain, Mr. K. Zacharia and Dr. B. C. Roy.

The Committee will make enquiries and recommendations regarding (1) the lines on which the Universities and other institutions of higher learning should develop, (2) the additional amounts in the form of grants-in-aid from public funds required for them, and (3) the co-ordination of their activities with a view to avoiding unnecessary overlapping.

## Indian Ecological Society

At the General Meeting of the Society, held on the 1st January 1948, at Patna, the following Office-bearers were elected:—Dr. T. S. Sabnis (President); Drs. L. A. Ramdas and R. Misra (Vice-Presidents); Dr. T. J. Job (Joint-Secretary); Dr. B. S. Navalkar (Treasurer); and Drs. B. Pal, N. K. Panniker, T. S. Sadashivan, Mrs. E. Gonzalves and Dr. T. S. Mahabale (Members of the Executive Council).

## Bureau for International Understanding

The creation in Britain of a Central Bureau for Educational Visits and Exchanges on behalf of the UNESCO, for promoting International understanding has been announced by the Minister of Education. It will co-operate actively with the various agencies in Britain and abroad and supplement them by undertaking the responsibility for arranging visits to Britain by teachers and students from abroad and for exchange trips to other countries from Britain.

## Sir C. V. Raman

Sir C. V. Raman has been invited to attend the International Conference of Physicists and Chemists at Bordeaux. He will proceed to Europe by the end of March to participate in the Conference. Among other subjects, 'Raman Effect' will be discussed at the Conference.

## Award of Doctorate

The D.Sc. degree of the Benares Hindu University has been awarded to Messrs. P. G. Deo and K. Venkateshwara Rao for research work carried out on the Joshi Effect.

## Research in Minerals

It is understood that the Government of India have decided to establish a Bureau of Mines for the purpose of research in Mines and Mineral Wealth. A recurring expenditure of about Rs. 3 lakhs has been sanctioned, it is understood, by the Standing Finance Committee.

## Madras University Endowment Lectureships

The Syndicate will proceed shortly to select persons to deliver lectures under the following Endowments for the year 1948-49. Applications for Lectureships will be received by the Registrar not later than the 15th March 1947. Applicants are requested to give full particulars regarding their qualifications, etc., and the subject selected by them for the lectures. Separate application should be submitted for each lectureship. The lectures are to be delivered before January 1949.

The following are the lectureships:—(1) The Maharaja of Travancore Curzon Lectureships (three); (2) The Sir Subramanya Ayyar Lectureship; (3) The Gokhale Lectureship; (4) The Sankara Parvati Lectureship; (5) The Sir William Meyer Lectureship; (6) The Principal Miller Lectureship; (7) The Dr. Elizabeth Matthai Lectureship; (8) The Rt.-Hon. V. S. Srinivasa Sastri Lectureship.

For further particulars regarding the lectureships, please see the University Calendar, Vol. I, Part I, 1945-46 (Appendix F).

## Elliot Prizes for Scientific Research

The Elliot Prize for Scientific Research for 1948 will be awarded to the author of the best original essays giving the results of original research or investigation in Mathematics and published during the years 1944-47.

The Elliot Prize for Scientific Research for 1949 will be awarded to the author of the best original essay giving the results of original research or investigation made by the candidate in Chemistry and published during the years 1945-48.

Any native of Bengal, Bihar or Orissa or any Anglo-Indian or domiciled European, residing in Bengal, Bihar or Orissa, may compete for the prize.

The essays of competitors must be sent in so as to reach the President of the Royal Asiatic



Society of Bengal, C/o the General Secretary, 1, Park Street, Calcutta, by the end of June 1948. Author's reprints, and not manuscripts, must be submitted.

Preference will be given to researches leading to discoveries likely to develop the industrial resources of Bengal, Bihar and Orissa.

The prizes for the next four years will be allotted as follows:—1949—Chemistry; 1950—Physics; 1951—Geology and Biology (including Pathology and Physiology); 1952—Mathematics.

All essays submitted must have been published during the four calendar years immediately preceding that for which the prize is given.

### Award for Sugar Research

The third \$5,000 Intermediate Sugar Research Award will be made by the National Science Fund, Washington, U.S.A., on or about March 15, 1948. Established by the Sugar Research Foundation to stimulate scientific studies of sugar as a food and an industrial raw material which may lead to its greater usefulness; awards of \$5,000 will be given in 1948 and 1949, with a Grand Prize of \$25,000 to be given in 1950 for the most significant discovery of the preceding five years. Further details of terms and conditions governing the award may be obtained from the Secretary, National Science Fund, 2101, Constitution Avenue, Washington 25, D.C.

### Mathematical Instruments Office

Two committees, one for reorganising the work of the Alipore Test House, Calcutta, and the other for expanding the scope and activities of the Mathematical Instruments Office, Calcutta, have been appointed by the Government of India in the Ministry of Industry and Supply.

The Government of India have appointed a Committee under the Chairmanship of Dr. B. C. Roy to examine the existing Organisation and the possibilities of expansion of the Government Test House, Alipore. Dr. Sir K. S. Krishnan, Dr. B. C. Guha and Mr. K. N. Sharma have been invited to serve on the Committee.

The Government of India have also appointed a Committee under the Chairmanship of Dr. G. R. Paranjpe to review the organisation of the Mathematical Instruments Office, Calcutta. The terms of reference include (i) the formulation of concrete plans, both short-term and long-term, for the development of the manufacture of scientific instruments and photographic, electronic and electro-acoustic equipment; (ii) an examination of the possibility of using the Mathematical Instruments Office as a training centre for instrument-makers, mechanics, etc.; and (iii) a review of the terms and conditions of service of the employees there.

### Quality Control

A Conference on Quality Control commenced its seven-day session in Calcutta on February 8.

Dr. W. A. Shewhart, American Expert on Quality Control, presided over the Conference. Dr. L. C. Verman, Director, Indian Standards Institution, in explaining the object of the Conference said that the Indian Standards Institution

and Indian Standards Institution, joint-organisers of this Conference, had come together to take the first step in initiating the introduction of statistical methods into India's industry on the lines which have been tried and proved a success in other parts of the world. Prof. P. C. Mahalanobis, Director of Statistical Institute, also addressed the Conference.

The object of industry and applied science in India, Dr. Shewhart said, should be to satisfy the wants of 400 million people. But one could not even find out what these wants were without the help of statistics, nor could one take the final step on research concerning the design, specifications, and techniques on each of these fundamental aspects of production.

The accommodation problem of four million refugees, for instance, involved new houses which could not be constructed without building material. The improvement of quality and the maintenance of proper standards were essential in making these different branches of production fit into one complete whole. There were many research organizations, plants and industries in India but what was lacking was co-operation between various groups. India could not develop, Dr. Shewhart continued, her vast resources unless science laboratories and industrial concerns worked together as a co-ordinated whole. Quality control would enable them to do this.

A technicolour film on quality control, made by Mr. Johns Hyphen Manville of U.S.A. for training their own workers and sent on loan by the firm to India through Dr. Shewhart, was shown at the Conference.

Nearly 200 representatives from various industries and research organisations all over India attended the Conference which is expected to continue its session for nearly a week.

### Indian Standards Institute

The Engineering Division Council of the Indian Standards Institution, met on November 17 and 18 and elected Mr. S. L. Kirsoskar as the Chairman.

The Standardization programme to be executed by this Council covers, among others, metallurgical, mechanical, electrical, structural, communications, aeronautical, ship-building and other industries. Among the subjects which will come under the purview of the Sectional Committees, to be set up under the Council, are the following: basic ferrous and non-ferrous metals, cement, timber products, lubricants, electrical plant and machinery, electrical conductors, insulators and accessories, gas cylinders, refractories, radio equipment, etc.

It was decided at the meeting that this Council, pending the formation of a Chemical Division Council, will deal with the standardization work of paints, varnishes and bituminous and tar products.

Nearly 200 technical subjects were proposed by various sources for standardization.

### Power Engineering Laboratory

Sir Vithal Chandavarkar, Chairman of the Governing Council of the Indian Institute of Science, Bangalore, laid the foundation-stone of the High Voltage Engineering Laboratory of

the Power Engineering Department on the 14th February. Prof. M. S. Thacker, Head of the Department of Power Engineering, requesting Sir Vithal to lay the foundation-stone, said that this Laboratory was one in the chain of many national laboratories to be set up in due course. The Laboratory when completed would serve the research needs in power and would be of primary importance in the development of electrical supply. The laboratory would cost Rs. 23 lakhs.

### Greenwich to Hurstmonceaux

The Royal Observatory at Greenwich is being moved to its new home at Hurstmonceaux in Sussex.

After the complete transfer the Observatory to Hurstmonceaux, the ancient buildings at Greenwich will stand as a national monument and as a museum to display all the historic instruments, including those of Halley and Bradley, Pond's transit circle, Bradley's zenith sector and the old quadrants. Most famous perhaps of them all is the Airy Transit Circle, on which, with its continuous use since 1851, no fewer than 650,000 observations have been made.

Greenwich will become an object of pilgrimage not only for astronomers, but also for countless visitors from all parts of the world.

### Coffee Pulp for Cattle Feed

From the waste pulp of the coffee bean comes a new concentrate for cattle for milk production. This has been developed by technicians in U.S.A. and El Salvador. Pound for pound, dried coffee pulp has been found an effective substitute for corn concentrates in the feed of milch cattle. Coffee pulp is the fleshy covering of the bean, and is at present largely a waste product. The palatability of the pulp is increased by mixing it with banana leaves, molasses of other feed stuff.

The popularisation of dried coffee pulp in India will be of great benefit as it creates a new source of income for the coffee grower, larger supply of concentrate to cattle owners and finally, increased milk production in the country.

### Indian Wattle Bark

The Indian *Babool* bark and *Avaram* bark are not rich sources of tannins, yielding only 14 per cent. tannin as compared to 64-65 per cent. of the imported bark.

It has been established by the Madras Forest Department that Nilgiris tan bark black wattle,

*Accacia mollissime* wild Syn., *Accacia decurrens* wild var. *meths.* Lin., are identical with Natal black wattle. The bark of the trees grown in the Palani Hills and the Nilgiris has a tannin content varying from 20 to 57 per cent. The species in the Madras Province requires an elevation of 5,000-7,000 ft. and a well distributed rainfall of 60" or more for best development. The Madras Government intends to cultivate these in Palani Hills, South Coimbatore Division, in Kollegal and North Coimbatore Hills. A Research Station is also to be started at Kodaikanal to deal with plantation, production, and marketing problems.

### The Smokeless "Herl" Chula

This is a simple smokeless and fuel-saving cooking range called "Herl" Chula, as it has been developed in the Hyderabad Engineering Research Laboratories, under the direction of Dr. S. P. Raju.

This structure is built of brick and mud or only mud, and plastered with fine earth, and consists of an "L"-shaped duct with three holes for the cooking pots and an opening for the firewood. At the end of the duct is an arrangement for a big pot of water so that the hot gases before going out are utilized further to heat the water pot, thus providing hot water for the family as a by-product. The gases are finally taken out of the range by means of a clay pipe, tile or mud chimney. The opening for firewood is 6 inches wide and 4 inches high, which is enough for a family of about six. For bigger families the width may be increased to 7 or 8 inches. The size of the opening is designed to be fool-proof against unnecessary shoving in of firewood.

### Geomagnetic Storms

Geomagnetic activity during the quarter October-December 1947 was very much on the decrease as compared with the earlier three quarters. Some details of the geomagnetic disturbances as recorded at the Alibag Magnetic Observatory are given in the following table in which  $t_0$ ,  $t$  represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively and  $T$  the duration of the intense phase expressed in hours. The ranges in the three different elements ( $D$ ,  $H$  and  $V$ ) of the earth's magnetic field have also been given.  $D$ , in minutes of arc,  $H$  and  $V$  in  $\gamma$  where  $1\gamma=10^{-5}$  gauss. The maximum  $k$ -index recorded during the disturbances have also been given.

Date	$t_0$	$t$	$T$	Range			$K_m$	Nature of commencement
				$D$	$H$	$V$		
1947	H. M.	h. m.	hrs.	min.	$\gamma$	$\gamma$		
September 30 to October 3	23 40	00 00	8	8.2	224	86	5	Sudden
November 9-10 ..	14 26	On Oct. 1 16 34	2½	5.1	217	46	6	Sudden

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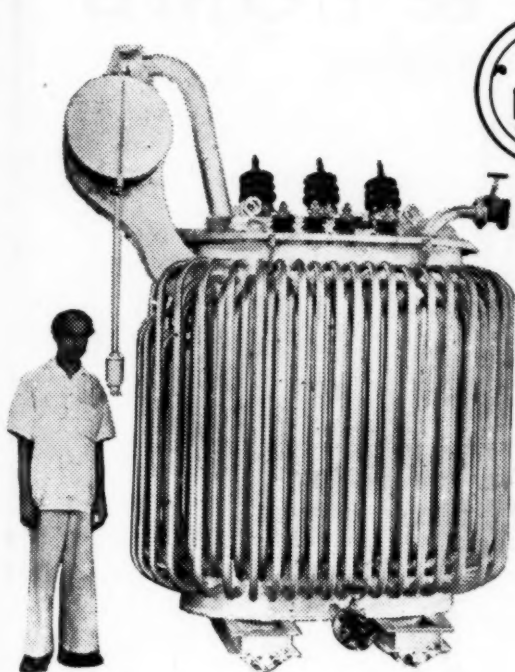
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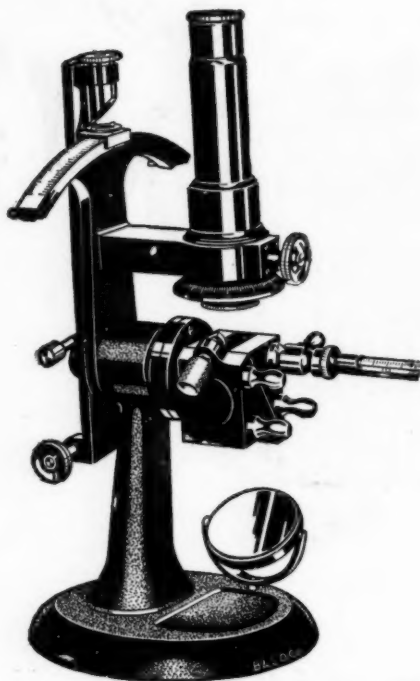
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